

General Specifications

Item	Specification
Lubricants and Sealants	
Motorcraft Premium Engine Coolant VC-4-A (In Oregon VC-5, In Canada CXC-10)	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A (In Oregon VC-7-B)	WSS-M97B51-A1
SAE 5W-20 Engine Premium Synthetic Blend Engine Oil XO-5W20-QSP	WSS-M2C153-H
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6
Engine	
Displacement	4.6L (4V) (281 CID)
Number of cylinders	8
Bore	90.2 mm (3.55 in)
Stroke	90.0 mm (3.54 in)
Firing order	1-3-7-2-6-5-4-8
Oil pressure	138-310 kPa
Oil capacity	6 ± 0.25 ^a
Compression ratio	8.5:1
Cylinder Head and Valve Train	
Cylinder head gasket surface flatness	0.10 mm (0.004 inch) max. overall
Combustion chamber volume	52.6 ± 0.5 cm
Valve arrangement (front to rear) ^b Intake (left hand):	S-P-S-P-S-P-S-P
Valve arrangement (front to rear) Exhaust (left hand):	E-E-E-E-E-E-E-E
Valve arrangement (front to rear) Intake (right hand):	P-S-P-S-P-S-P-S
Valve arrangement (front to rear) Exhaust (right hand):	E-E-E-E-E-E-E-E
Valve guide bore diameter	7.015-7.044 mm (0.2762-0.2773 in)
Valve stem diameter—intake	6.975-6.995 mm (0.2754-0.2746 inch)
Valve stem diameter—exhaust	6.949-6.970 mm (0.2744-0.2736 inch)
Valve stem-to-guide clearance—intake	0.020-0.069 mm (0.00078-0.00272 inch)
Valve stem-to-guide clearance—exhaust	0.046-0.094 mm (0.0018-0.0037 in)
Valve head diameter—intake	37 mm (1.46 inch)

Valve head diameter—exhaust	30 mm (1.18 inch)
Valve face runout	0.05 mm (0.002 in)
Valve face angle	45.5 degrees
Valve seat width—intake	1.8-2.2 mm (0.071-0.086 inch)
Valve seat width—exhaust	1.8-2.2 mm (0.071-0.086 inch)
Valve seat runout	0.05 mm (0.002 inch)
Valve seat angle	45 degrees
Valve spring free length—intake	42.16 mm (1.6598 inch)
Valve spring free length—exhaust	42.16 mm (1.6598 inch)
Valve spring squareness	2 degrees
Valve spring compression pressure—intake	711.47 N @ 26.19 mm (159.9 lb-ft @ 1.031 inch)
Valve spring compression pressure—exhaust	711.47 N @ 26.19 mm (159.9 lb-ft @ 1.031 inch)
Valve spring installed height	36.14 mm (1.4228 in)
Valve spring installed pressure—intake	289.1 N @ 36.14 mm (64.99 lb-ft @ 1.4228 inch)
Valve spring installed pressure—exhaust	289.1 N @ 36.14 mm (64.99 lb-ft @ 1.4228 inch)
Roller follower ratio	1.8:1
Hydraulic Lash Adjuster	
Diameter	16.000-15.988 mm (0.6299-0.6294 inch)
Clearance-to-bore	0.018-0.069 mm (0.000709-0.002717 inch)
Service limit	0.016 mm (1.0006299 inch)
Hydraulic leakdown rate °	5-25 seconds
Collapsed lash adjuster gap	0.80-1.20 mm (0.0315-0.0472 inch)
Camshaft	
Theoretical valve lift @ 0 lash—intake (primary and secondary)	10.0 mm (0.3937 inch)
Theoretical valve lift @ 0 lash—exhaust	10.0 mm (0.3937 inch)
Lobe lift	5.54 mm (0.218 in)
Allowable lobe lift loss	0.130 mm (0.0051 in)
Journal diameter	26.962-26.936 mm (1.0615-1.0605 inch)
Camshaft journal bore inside diameter	27.012-26.987 mm (1.0635-1.0625 in)
Camshaft journal-to bearing clearance	0.025-0.076 mm (0.00098-0.002992 inch)
Runout	0.025 mm (0.0010 in)
End play	0.025-0.165 mm (0.00098-0.00649 inch)
Cylinder Block	
Cylinder bore diameter	90.2-90.239 mm
Cylinder bore maximum taper	0.016 mm
Cylinder bore maximum out-of-round	0.016 mm
Main bearing bore diameter	72.402-72.422 mm

Head gasket surface flatness	0.15 mm (0.006 in) max. overall
Crankshaft	
Main bearing journal diameter	67.493 mm
Main bearing journal maximum taper	0.05 mm
Main bearing journal maximum out-of round	0.05 mm
Main bearing journal-to-cylinder block clearance	0.023-0.055 mm
Connecting rod journal diameter	56.866-56.886 mm
Connecting rod journal maximum taper	0.004 mm (0.0002 in)
Connecting rod journal maximum out-of-round	0.004 mm (0.0002 in)
Crankshaft maximum end play	0.130-0.301 mm
Thrust bearing journal diameter	67.493 mm
Thrust bearing journal maximum out-of round	0.05 mm
Thrust bearing journal maximum taper	0.05 mm
Thrust bearing journal length	17.725-17.775 mm
Piston and Connecting Rod	
Piston diameter	90.180-90.191 mm
Piston-to-cylinder bore clearance	-0.010/+0.026 mm
Piston ring end gap — compression (top)	0.30 mm
Piston ring end gap — compression (bottom)	0.50 mm
Piston ring end gap — compression (oil ring)	0.65 mm
Piston ring groove width — compression (top)	1.53-1.549 mm
Piston ring groove width — compression (bottom)	1.519-1.539 mm
Piston ring groove width — oil ring	3.031-3.055 mm
Piston ring width — compression (top)	1.47-1.49 mm
Piston ring width — compression (bottom)	1.47-1.49 mm
Piston ring width — oil ring	2.854-2.984 mm
Piston ring-to groove clearance — compression (top)	0.04-0.079 mm
Piston ring-to groove clearance — compression (bottom)	0.029-0.069 mm
Piston ring-to groove clearance — oil ring	0.047-0.201 mm
Piston pin bore diameter	22.0042-21.998 mm
Piston pin diameter	21.991-29.994 mm
Piston pin length	61.60-62.03 mm
Piston pin-to-piston fit	0.0058-0.0132 mm
Connecting rod-to-pin clearance	0.018-0.033 mm
Connecting rod pin bore diameter	22.012-22.024 mm
Connecting rod length	150.7 mm
Connecting rod maximum allowed bend	0.038 mm per 25 mm
Connecting rod maximum allowed twist	0.050 mm per 25 mm
Connecting rod bearing bore diameter	56.866-56.886 mm
Connecting rod bearing-to-crankshaft clearance	0.027-0.069 mm
Connecting rod side clearance	0.15-0.45 mm

^a With installation of a new filter.

^b P=Primary, S=Secondary, E=Exhaust

^c Time necessary for plunger to leak down 1.6 mm of travel with 222 N force and leak down fluid in tappet.

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor bolts	25	18	—
A/C peanut fittings	8	—	71
A/C muffler nut	25	18	—
Accelerator bracket bolts	10	—	89
Battery tray bolts	11	8	—
Belt idler support bracket assembly fasteners	25	18	—
Camshaft sprocket bolt	115	85	—
Coolant bypass tube studs	25	18	—
Coolant bypass tube bolts	25	18	—
Coolant hose and tube assembly bolt	25	18	—
Cooling fan motor and shroud bolts	10	—	89
Connecting rod bolt ^a	—	—	—
Engine front cover bolt	a	a	a
Drive belt tensioner bolts	25	18	—
Cylinder head bolt ^a	—	—	—
Idler pulley bracket	25	18	—
Power steering pump bolts	25	18	—
Power steering hose fitting	65	48	—
Power steering hose bracket bolt	10	—	89
Pulley to crankshaft bolt ^a	—	—	—
EGR valve to intake manifold ^a	—	—	—
Engine coolant degas bottle bolts	10	—	89
Exhaust manifold studs	25	18	—
Generator bolts	25	18	—
Generator support bracket bolts	25	18	—
Hood prop bolt	10	—	89
Hood mounting nuts	12	9	—
Heater water inlet tube	10	—	89
Heater water outlet tube	24	18	—
Lower intake manifold-to-cylinder head bolt ^a	—	—	—
Main bearing cap bolt ^a	—	—	—
Oil filter adapter bolt	25	18	—
Oil bypass filter to adapter	50	37	—
Oil pump screen cover and tube-to-oil pump bolt	10	—	89
Oil pan-to-cylinder block bolt ^a	—	—	—

Oil pan-to-engine front cover bolts ^a	—	—	—
Oil pump-to-cylinder block bolt	10	—	89
Radio ignition interference capacitor bolts	25	18	—
Oil pump screen and pickup tube-to-main bearing cap stud spacer bolt	25	18	—
Water pump pulley bolts	25	18	—
Throttle body spacer nuts	25	18	—
Vacuum accessory bracket fasteners	10	—	89
Valve cover bolt	10	—	89
Wiring harness support bracket	25	18	—
Water pump-to-cylinder block bolt	25	18	—
EGR valve to exhaust manifold tube nuts	40	30	—
Power steering pump to engine	25	18	—
Power steering hose bracket nut	25	18	—
Power steering reservoir bracket fasteners	10	—	89
Supercharger degas bottle bolts	10	—	89
Camshaft cap cluster to cylinder head	10	—	89
Timing chain tensioner bolts—primary	25	18	—
Timing chain tensioner bolts—secondary	10	—	89
Ignition coil cover bolts	10	—	89
Generator mounting bracket retainers	10	—	89
Oil level indicator tube retainer	10	—	89
Primary timing chain guide-to-engine bolts	10	—	89
Oil pump screen and pickup tube spacer to main bearing stud	25	18	—
Belt idler pulley bolt	25	18	—
Subframe brace nuts	41	30	—

^a Refer to the procedure.

Engine



WARNING: Do not operate the engine with the hood open until the fan blade has been first examined for possible cracks and separation.

The 4.6L (4V) (281 CID) Cobra engine is a V-8 with the following features:

- intercooled supercharger
- dual overhead camshafts
- four valves per cylinder
- sequential multiport fuel injection (SFI)
- an aluminum intake manifold
- aluminum cylinder heads
- a cast aluminum, 90-degree V- cylinder block
- individually chain-driven camshafts with a hydraulic timing chain tensioner on each timing chain
- the electronic ignition system with eight ignition coils

Identification

Always refer to these labels when replacement parts are necessary or when checking engine calibrations. The engine parts often differ within a CID family. Verification of the identification codes will ensure that the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their application.

Code Information

The engine code information label, located on the side of the valve cover and the front side of the valve cover, contains the following:

- engine build date
- engine plant code
- engine code

Exhaust Emission Control System

Operation and necessary maintenance of the exhaust emission control devices used on this engine is covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The sequential multiport fuel injection (SFI) provides the fuel/air mixture needed for combustion in the cylinders. The eight solenoid-operated fuel injectors:

- are mounted in the lower intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.

- are positioned so that their tips direct fuel just ahead of the engine intake valves.
- are connected in series with the fuel pressure sensor.
- supply fuel from the fuel tank with a fuel pump mounted in the fuel tank.

A constant fuel pressure drop is maintained across the fuel injectors by the fuel pressure sensor. The fuel pressure sensor:

- is positioned upstream from the fuel injectors on the fuel injection supply manifold.

Valve Train

The valve train operates as follows:

- ball-tip hydraulic lash adjusters provide automatic lash adjustment.
- roller followers ride on the camshaft lobes, transferring the up-and-down motion of the camshafts to the valves in the cylinder heads.

Positive Crankcase Ventilation System

All engines are equipped with a closed-type positive crankcase ventilation system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system operates as follows:

- oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- oil is pumped through the oil bypass filter on the left front side of the cylinder block.
- oil enters the main oil gallery where it is distributed to the crankshaft main journals and to both cylinder heads.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston rings assembly.
- The left cylinder head is fed from a drilling into the supply passage feeding the main gallery at the front of the cylinder block. The right cylinder head is fed from a drilling into the rear of the main gallery. Main gallery pressure is reduced as it enters the cylinder head galleries through fixed serviceable orifices located at the upper part of the feed passages. It is this reduced pressure in the cylinder head galleries which feeds the camshaft journals, the hydraulic lash adjusters and the primary and secondary timing chain tensioners.
- The camshaft lobe and roller followers are lubricated by splash created through valve train operation.

Oil Pump

The lubrication system of the 4.6L (4V) engine is designed to provide optimum oil flow to critical components of the engine through its entire operating range. The heart of the system is a positive displacement internal gear oil pump using top seal rotors. Generically this design is known as a gerotor pump, which operates as follows.

- The oil pump is mounted on the front face of the cylinder block.

- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to ensure correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Cooling System

The engine cooling system includes the following:

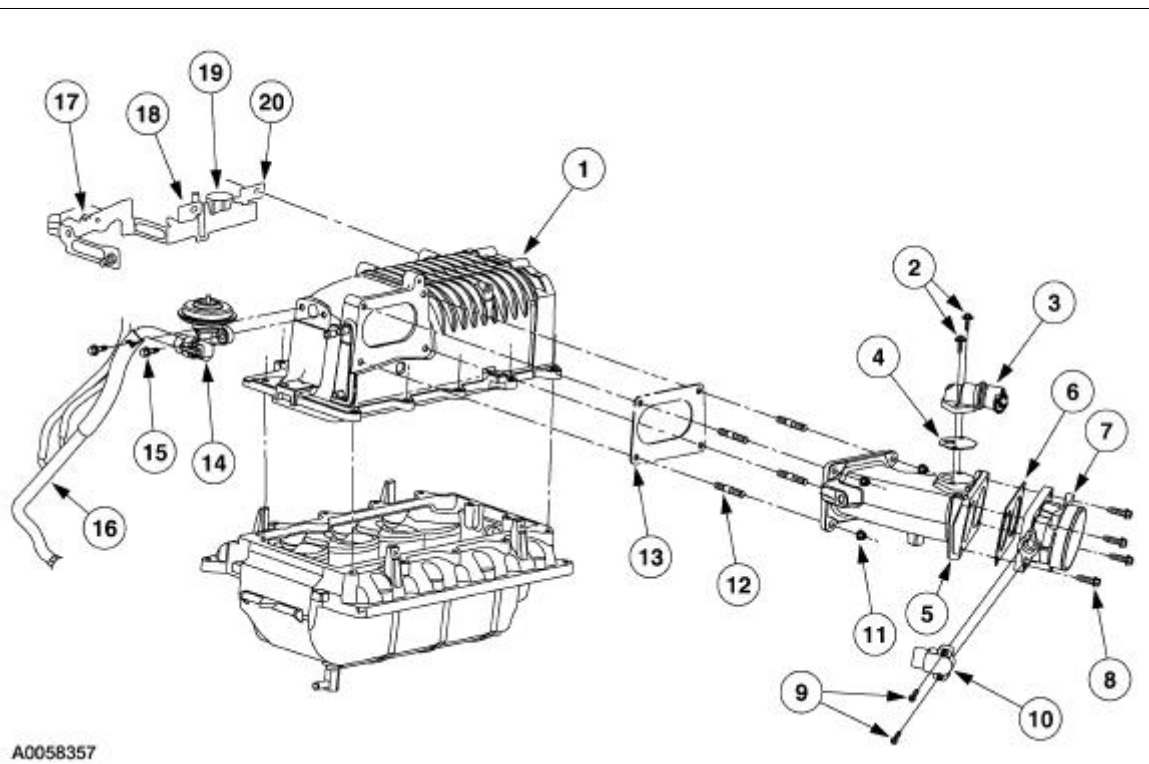
- radiator
- water pump
- the electric cooling fan motor and fan blade, activated by the variable control module
- the degas bottle, which aids in maintaining the correct volume of engine coolant
- water thermostat
- upper radiator hose
- lower radiator hose
- heater water hoses

Drive Belt System

The 4.6L (4V) DOHC engine is equipped with a serpentine drive belt. To ensure maximum life, a replacement drive belt should be of the same type as originally installed.

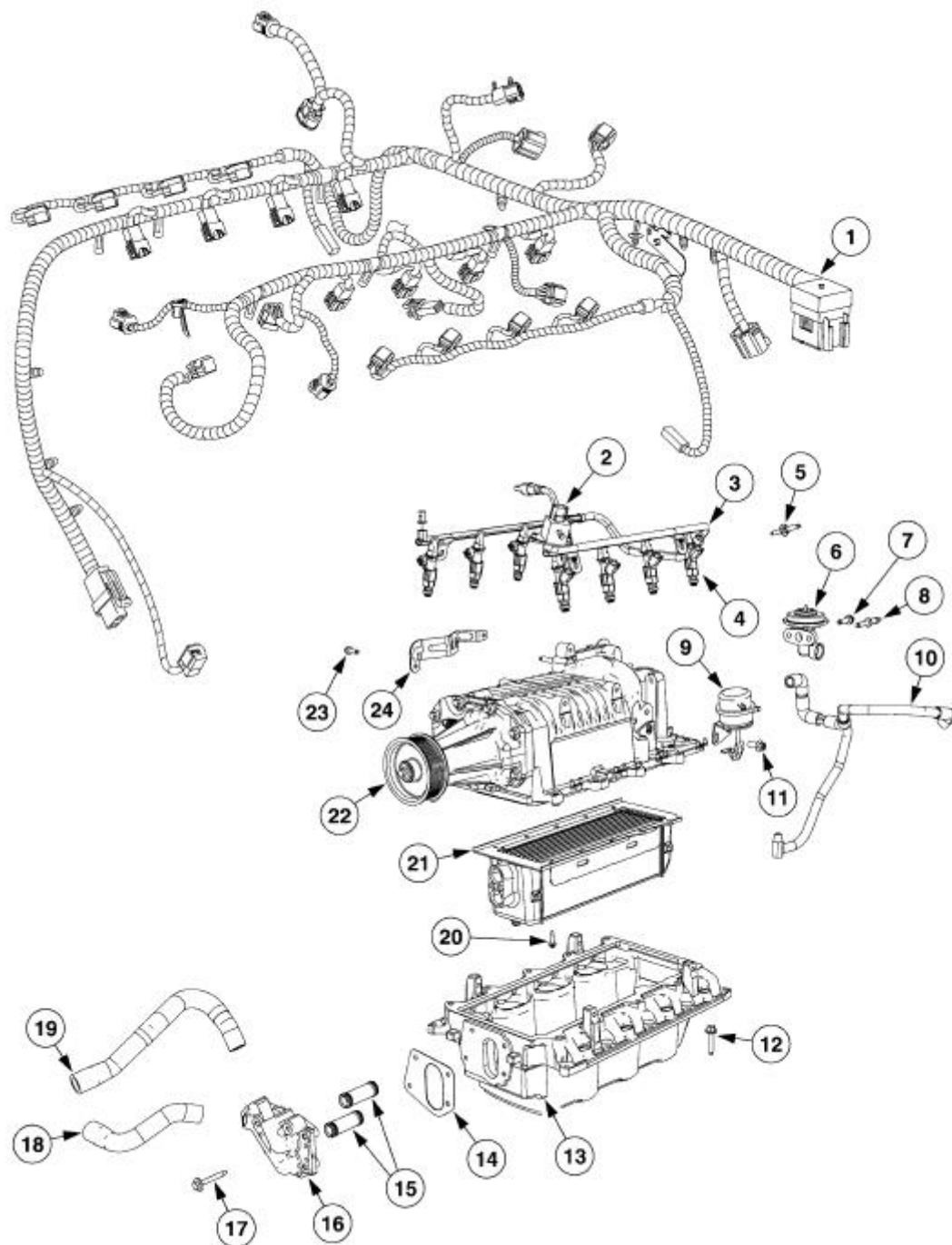
- The accessories mounted on the front of the engine are belt-driven by the crankshaft.
- The serpentine drive belt is routed over each accessory pulley, driven by the crankshaft pulley bolted to the crankshaft.

For service procedures, including tensioning, refer to [Section 303-05](#).



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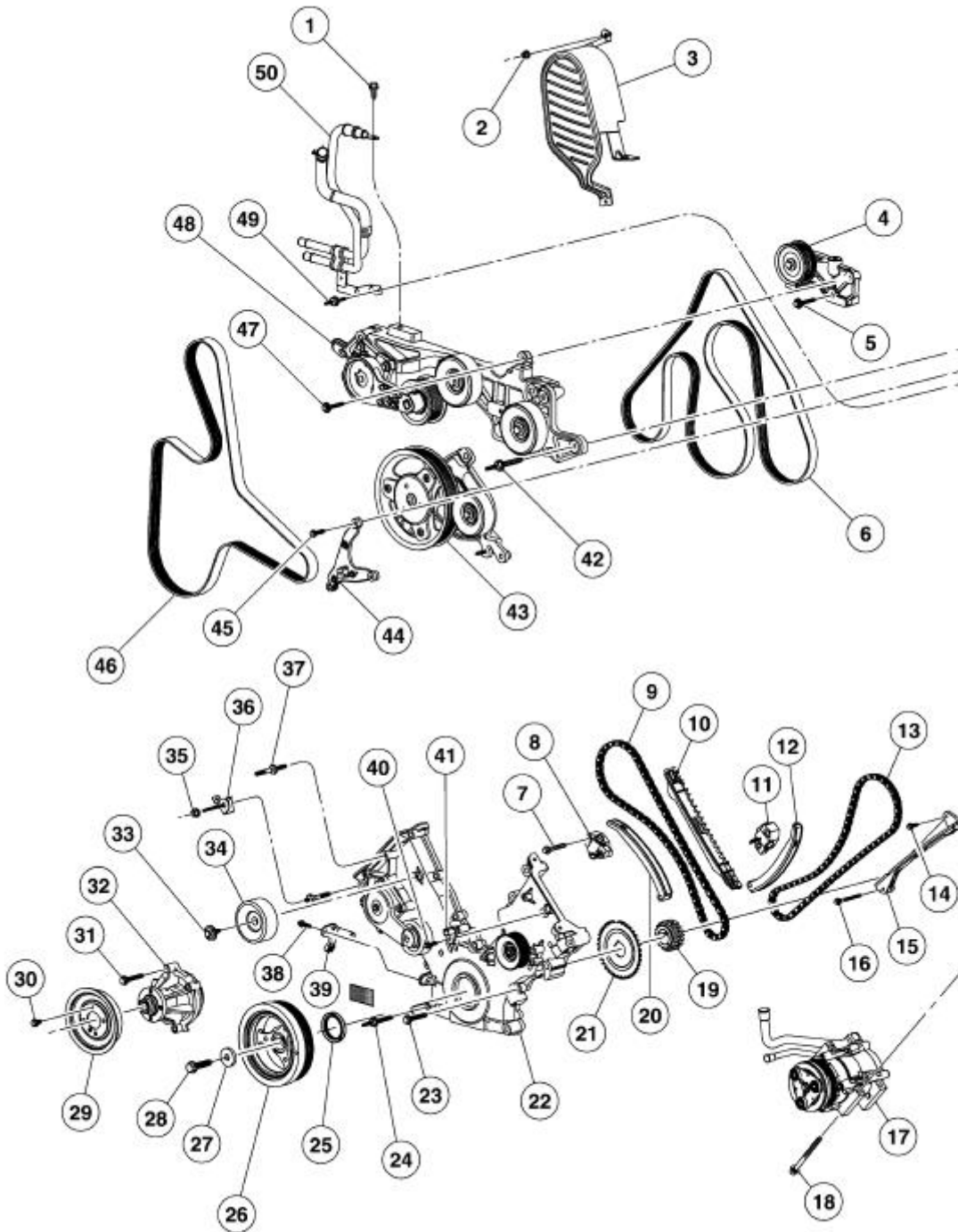
Item	Part Number	Description
1	6F066	Supercharger assembly
2	N806154	Screws (2 req'd)
3	9F715	Idle air control valve
4	—	Idle air control valve gasket
5	9P697	Spacer assembly
6	9E936	Throttle body gasket
7	9E926	Throttle body
8	—	Bolts (4 req'd)
9	—	Bolts (2 req'd)
10	9E926	Throttle position sensor
11	N804178	Nuts (4 req'd)
12	—	Studs (4 req'd)
13	—	Spacer assembly gasket
14	9D475	Exhaust gas recirculation valve
15	—	Stud
16	9D477	Exhaust gas recirculation tube
17	—	Manifold absolute pressure sensor
18	9J460	Differential pressure feedback EGR system
19	9J459	Exhaust gas recirculation vacuum regulator
20	9J472	Vacuum accessory bracket



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Item	Part Number	Description
1	12B637	Wiring harness
2	9C986	Fuel pulse damper
3	9F792	Fuel injection supply manifold
4	9F593	Fuel injector
5	—	Stud
6	9D475	Exhaust gas recirculation valve
7	W701232	Bolt
8	N806979	Stud

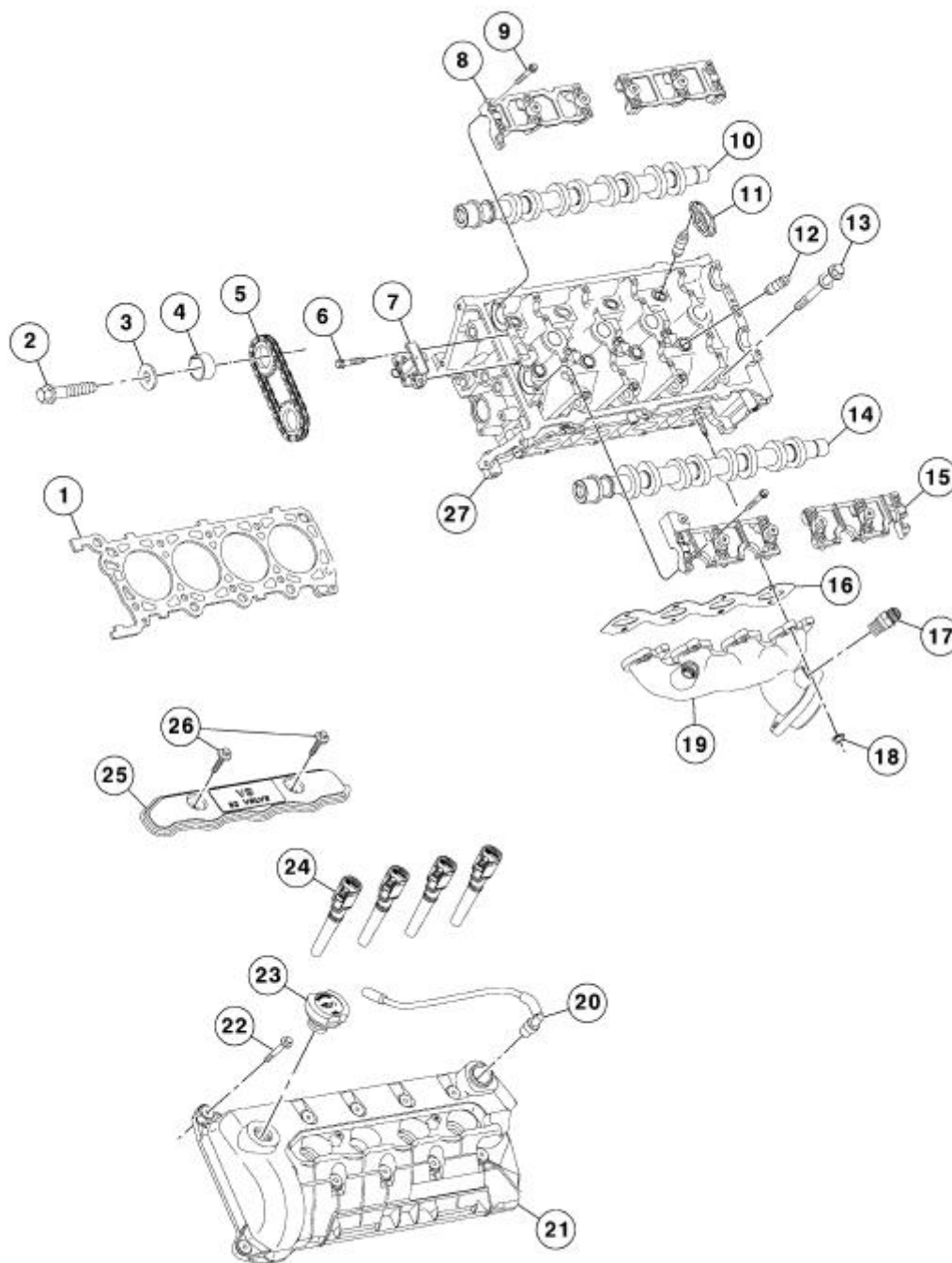
9	—	EGR vacuum hoses
10	6F089	Vacuum actuator valve
11	N605892	Bolts (2 req'd)
12	—	Bolts (10 req'd)
13	9J447	Lower intake manifold
14	9L438	Coolant intake manifold gasket
15	—	Coolant tubes
16	9N491	Coolant intake manifold
17	W701592	Bolt
18	NL443	Inter cooler hose
19	NL443	Inter cooler hose
20	W506404	Bolts (10 req'd)
21	6K755	Charge air cooler
22	6F066	Supercharger assembly
23	N605892	Bolt
24	9726	Accelerator cable bracket



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Item	Part Number	Description
1	N605904	Bolt
2	N620480	Nut
3	6A946	Cover
4	17K814	Alternator bracket assembly
5	N811268	Bolts (2 req'd)
6	8620	Accessory drive belt
7	N606543	Bolt (4 req'd)
8	6L266	Timing chain tensioner

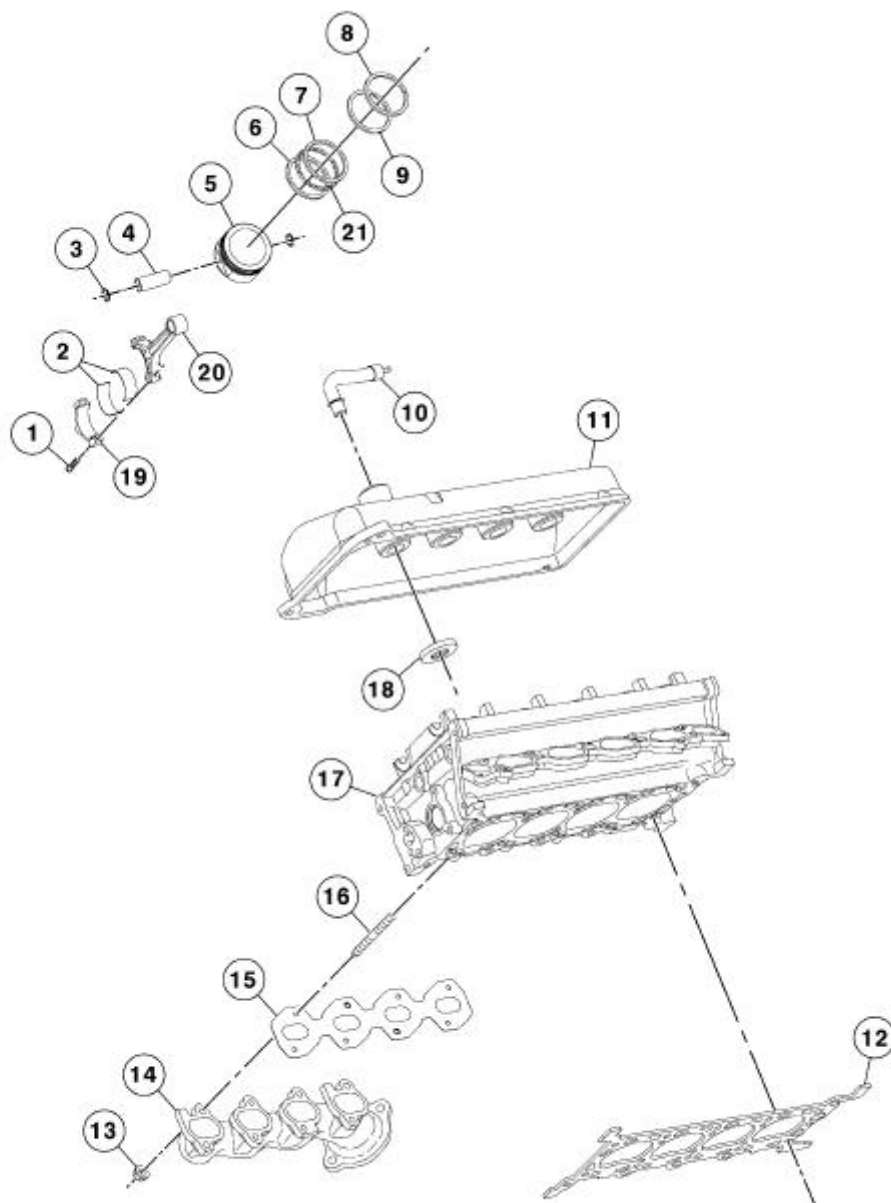
9	6268	Timing chain (2 req'd)
10	6M256	Timing chain guide
11	6L266	Timing chain tensioner
12	6L253	Timing chain tensioner arm
13	6268	Timing chain (2 req'd)
14	N804958	Bolt (2 req'd)
15	6B274	Timing chain guide
16	N606527	Bolt
17	19D269	A/C compressor
18	N806184	Bolts (3 req'd)
19	6306	Crankshaft sprocket
20	6L253	Timing chain tensioner arm
21	12A227	Ignition pulse ring
22	6C086	Engine front cover
23	N806177	Bolts (8 req'd)
24	N806300	Studs (5 req'd)
25	6700	Crankshaft front seal
26	6316	Crankshaft pulley
27	N806165	Washer
28	W701512	Stud
29	8A528	Water pump pulley
30	N806282	Bolts (4 req'd)
31	N806177	Bolts (4 req'd)
32	8501	Water pump
33	N808102	Bolt
34	19A216	Belt idler pulley
35	N804178	Nut
36	N806300	Harness support bracket
37	N806300	Stud
38	N806155	Bolt
39	6C315	Crankshaft position sensor
40	N806155	Bolt
41	6B288	Camshaft position sensor
42	N808920	Bolts (3 req'd)
43	6C254	Crankshaft extension support pulley
44	10153	Lower support bracket
45	N605909	Bolts (2 req'd)
46	8620	Accessory drive belt
47	N811268	Bolt
48	8B603	Belt idler bracket support
49	N808198	Stud
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Item	Part Number	Description
1	6083	Cylinder head gasket
2	—	Bolt (2 req'd)
3	—	Washer (2 req'd)
4	6255	Spacer
5	—	Secondary timing chain (2 req'd)
6	—	Screw and washer
7	6C271	Timing chain vibration damper

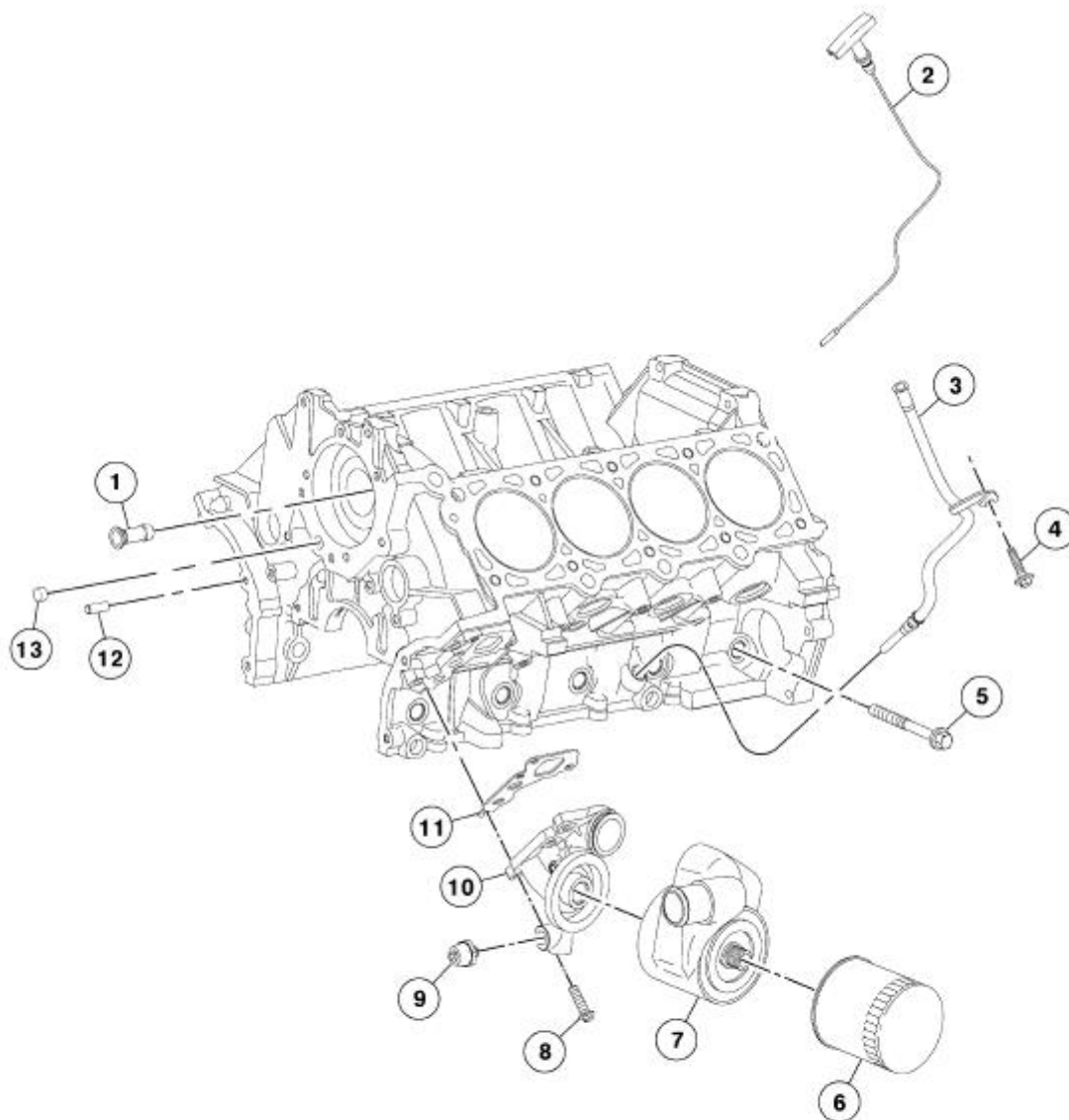
8	6B277	Camshaft bearing cap
9	—	Bolt (24 req'd)
10	6A271	Camshaft
11	6529	Roller follower (8 req'd)
12	6C501	Hydraulic lash adjuster
13	6065	Bolt (20 req'd)
14	6A273	Camshaft
15	6B278	Camshaft bearing cap (2 req'd)
16	9448	Exhaust manifold gasket
17	9F485	EGR valve tube to manifold connector
18	W701706	Nut (8 req'd)
19	9431	Exhaust manifold
20	6C324	PCV tube
21	6A505	Valve cover
22	N808199	Bolt (20 req'd)
23	6766	Oil filler cap
24	12A366	Ignition coils
25	6P068	Ignition coil cover
26	N807309	Bolt (4 req'd)
27	6050	Cylinder head



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Item	Part Number	Description
1	6214	Bolt (2 req'd)
2	6211	Connecting rod bearing (16 req'd)
3	6140	Piston pin retainer (16 req'd)
4	6135	Piston pin (8 req'd)
5	6110	Piston (8 req'd)
6	6159	Piston ring (8 req'd)
7	6159	Piston ring (8 req'd) (part of 6100)
8	6150	Piston ring (8 req'd) (part of 6100)

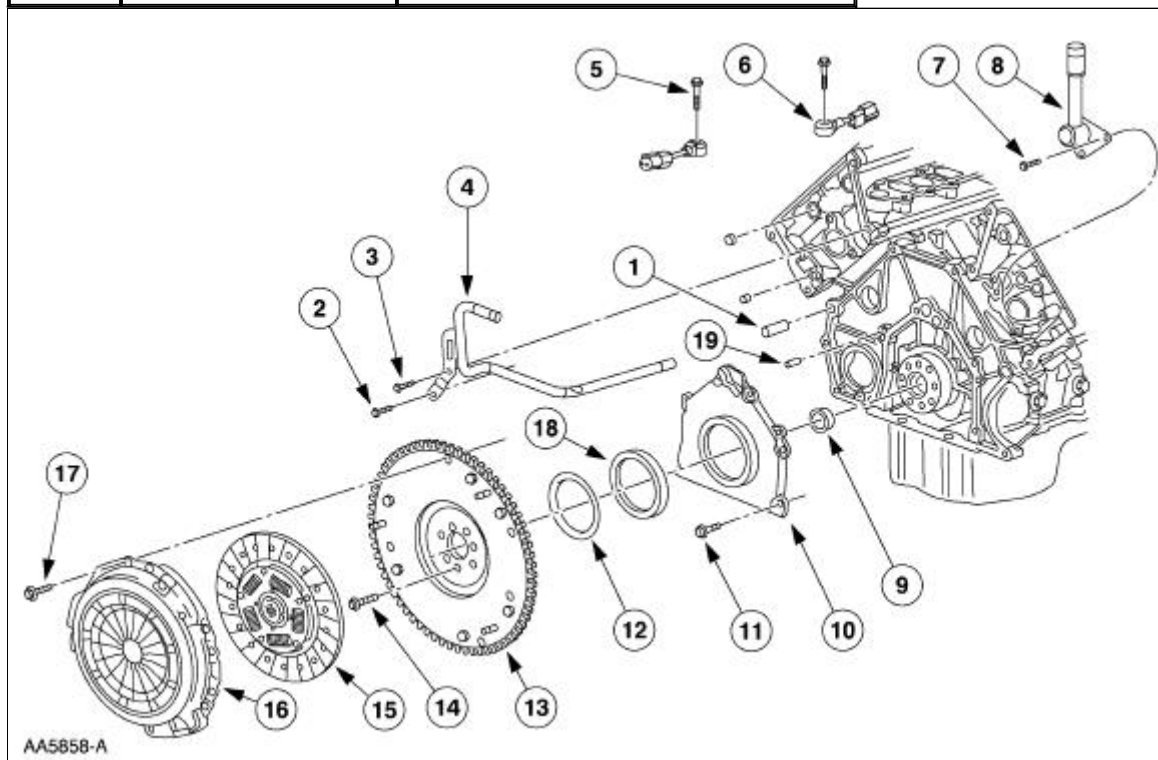
9	6152	Piston ring (8 req'd)
10	6758	Crankcase vent tube and connector
11	6582	Valve cover
12	6051	Cylinder head gasket
13	W701706	Nut (8 req'd)
14	9430	Exhaust manifold
15	9448	Exhaust manifold gasket
16	W701681	Stud (8 req'd)
17	6049	Cylinder head
18	6C527	Spark plug gasket (8 req'd)
19	6200	Connecting rod (8 req'd)
20	6200	Connecting rod (8 req'd)
21	6161	Piston ring (8 req'd)



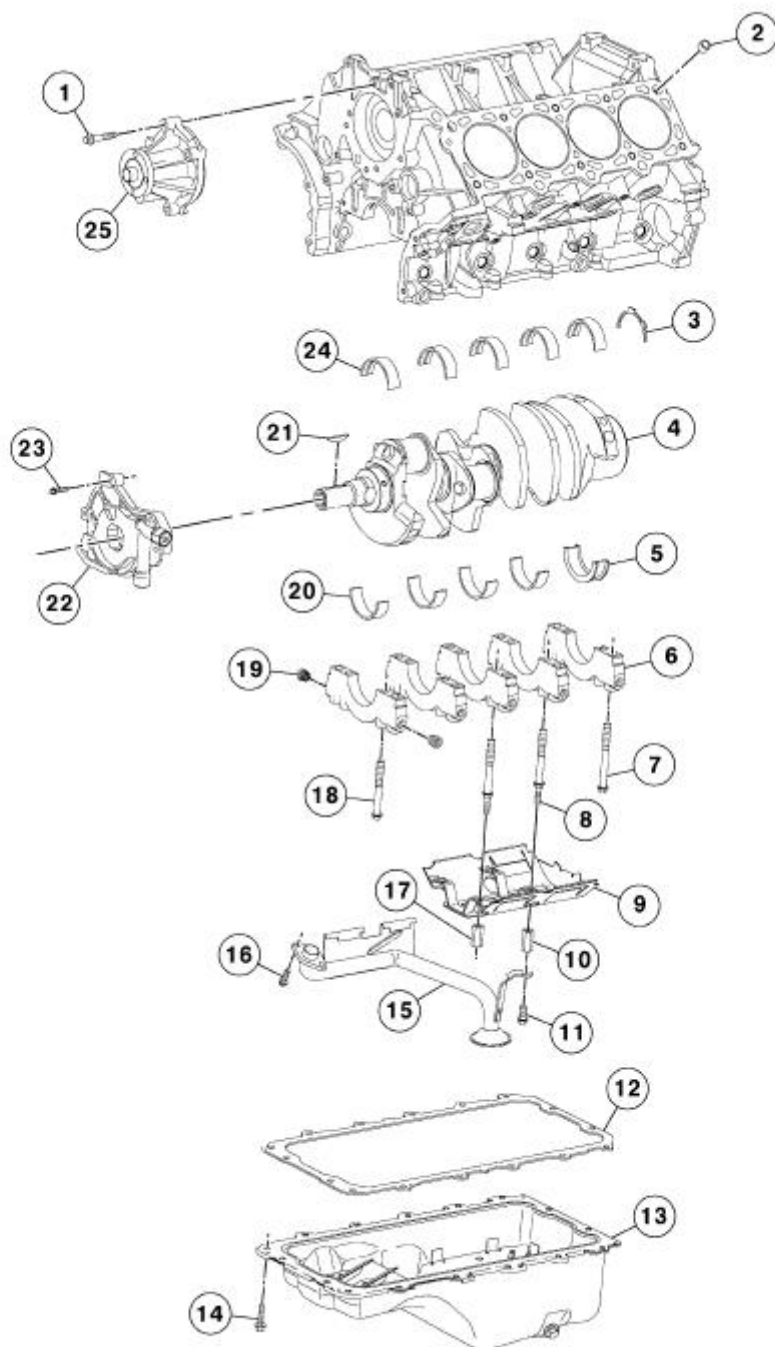
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Item	Part Number	Description
1	8555	Water bypass tube
2	6750	Oil level indicator
3	6754	Oil level indicator tube
4	N806155	Bolt
5	6C358	Bolt (10 req'd)
6	6714	Oil bypass filter
7	6A642	Oil cooler
8	N806156	Bolt (4 req'd)

9	9278	Oil pressure sender
10	6884	Oil filter adapter
11	6A636	Oil filter adapter gasket
12	N620482	Dowel
13	87836	Plug



Item	Part Number	Description
1	N807198	Dowel pin (2 req'd)
2	N807309	Bolt
3	N807959	Bolt
4	18663	Heater water hose
5	W500110	Bolt (2 req'd)
6	12A699	Knock sensor (2 req'd)
7	N807309	Bolt (2 req'd)
8	18696	Heater water hose
9	7120	Pilot bearing
10	6K318	Crankshaft rear retainer
11	N806155	Bolt (6 req'd)
12	6310	Crankshaft oil slinger
13	6375	Flywheel
14	N808139	Bolt (8 req'd)
15	7550	Clutch disc
16	7563	Clutch pressure plate
17	N808969	Bolt (6 req'd)
18	6701	Crankshaft rear oil seal



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Item	Part Number	Description
1	N806177	Bolt (4 req'd)
2	N806459	Dowel (4 req'd)
3	6A341	Thrust washer
4	6303	Crankshaft
5	6A339	Thrust bearing
6	6325	Main bearing cap (5 req'd)
7	6345	Bolt (10 req'd)

8	6K258	Stud (4 req'd)
9	6687	Oil pan baffle
10	N806180	Spacer
11	N605904	Bolt
12	6710	Oil pan gasket
13	6675	Oil pan
14	W701240	Bolt (16 req'd)
15	6622	Oil pump screen pickup and tube
16	N806155	Bolt (2 req'd)
17	N811280	Spacer (3 req'd)
18	6345	Bolt (6 req'd)
19	6C360	Main bearing cap adjusting screw (10 req'd)
20	6A338	Crankshaft main bearing (4 req'd)
21	N806201	Woodruff key
22	6621	Oil pump
23	N806183	Bolt (4 req'd)
24	6333	Crankshaft main bearing
25	8501	Water pump

Engine

Refer to [Section 303-00](#) for basic mechanical concerns or refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for driveability concerns.

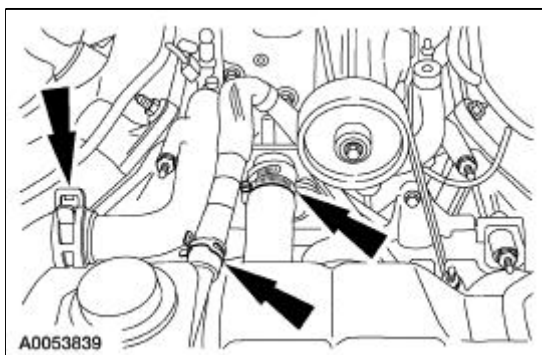
Lower Intake Manifold

Material

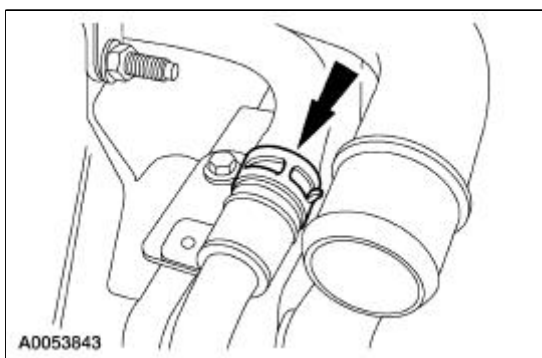
Item	Specification
Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) (green color)	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

Removal and Installation

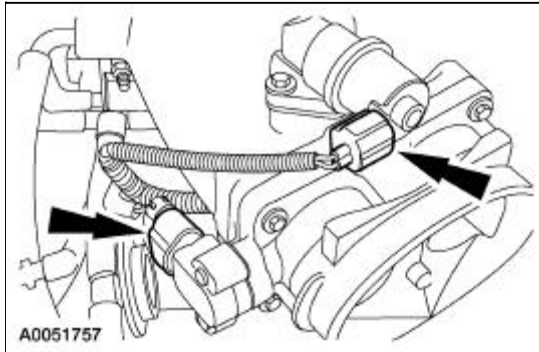
1. Drain the engine coolant. For additional information, refer to [Section 303-03A](#) in this section.
2. Drain the supercharger coolant. For additional information, refer to [Section 303-03B](#).
3. Release the fuel system pressure. For additional information, refer to [Section 310-00](#).
4. Disconnect the radiator upper hose, radiator lower hose and the supercharger degas hose.



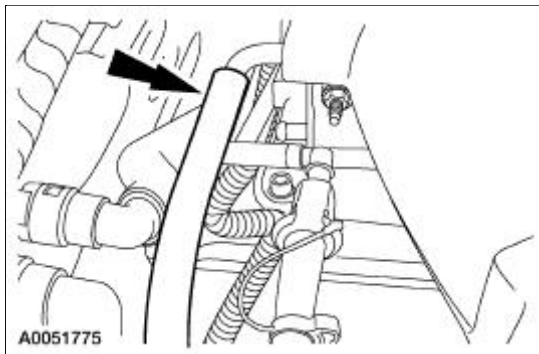
5. Remove the supercharger belt. For additional information, refer to [Section 303-05](#).
6. Disconnect the coolant hose.



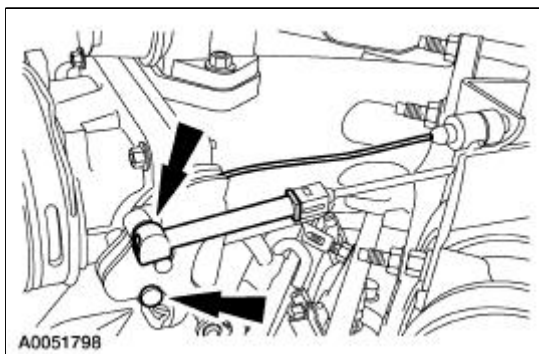
7. Remove the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
8. Disconnect the throttle position (TP) sensor and the idle air control (IAC) valve electrical connectors.



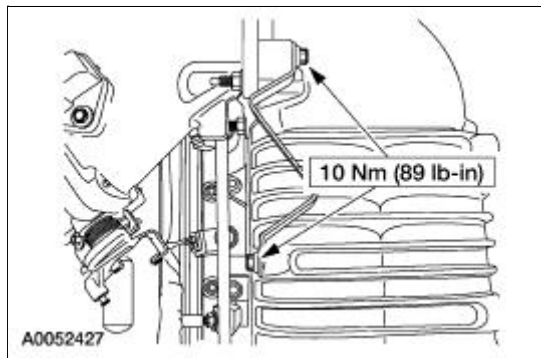
9. Disconnect the vacuum hose.



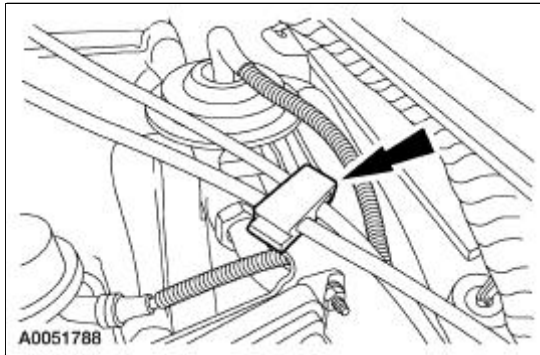
10. Disconnect the fuel hose spring lock coupling. For additional information, refer to [Section 310-00](#).
11. Disconnect the accelerator controls.
 - Disconnect the accelerator cable.
 - If equipped, disconnect the speed control cable.



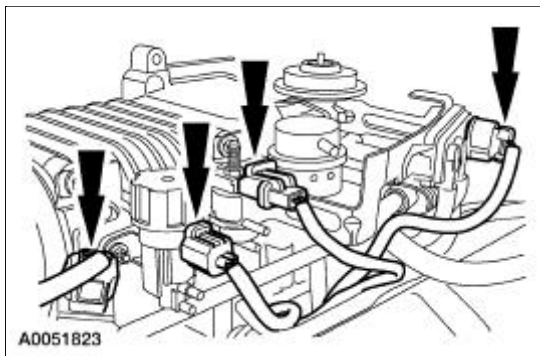
12. Remove the accelerator cable bracket bolts.



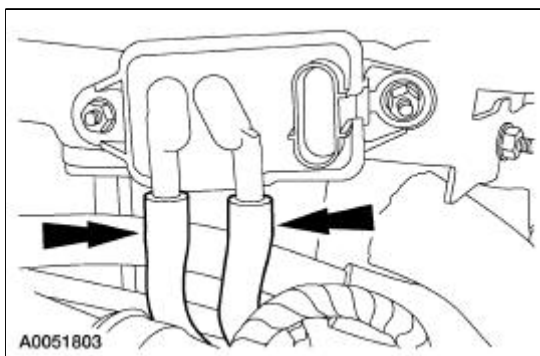
13. Release the clip and position the accelerator cable bracket and the cables aside.



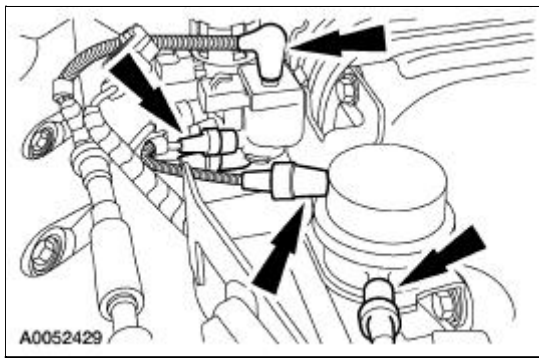
14. Disconnect the electrical connectors from the fuel pulse damper, exhaust gas recirculation (EGR) vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



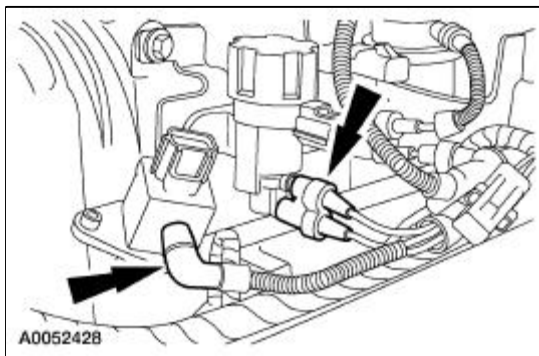
15. Disconnect the vacuum hoses from the differential pressure feedback EGR system.



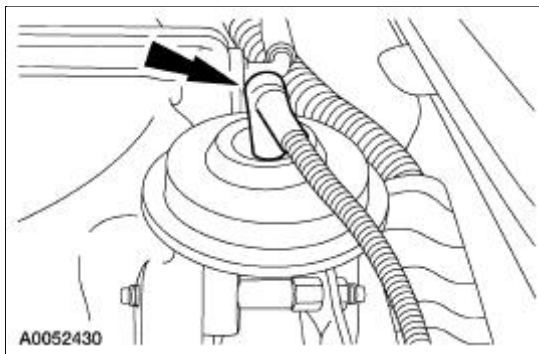
16. Disconnect the vacuum hoses from the supercharger bypass vacuum solenoid and the actuator.



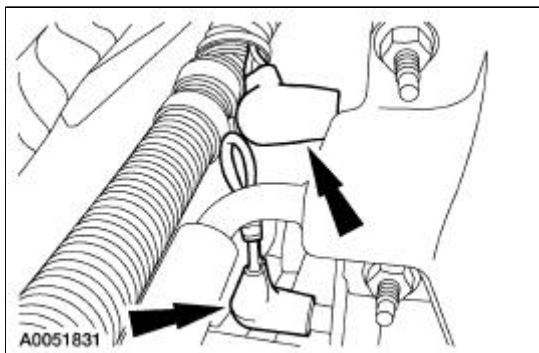
17. Disconnect the vacuum hoses from the fuel pulse damper and the EGR vacuum regulator solenoid.



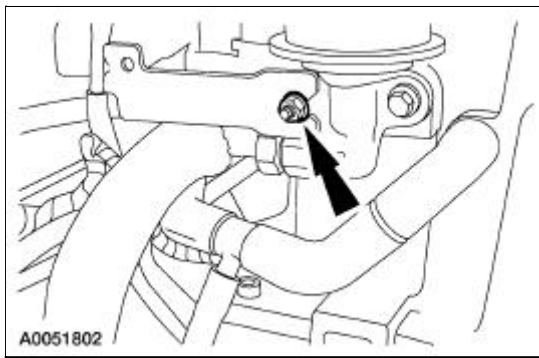
18. Disconnect the vacuum hose from the EGR valve.



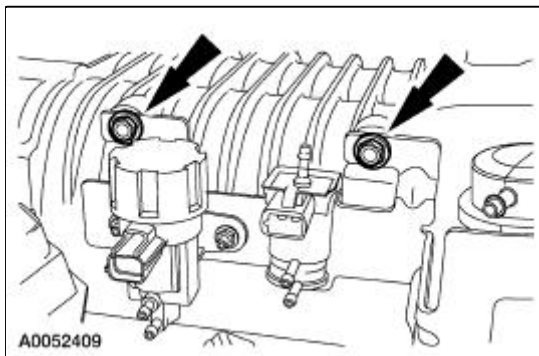
19. Disconnect the vacuum hoses at the back of the supercharger and position the vacuum harness aside.



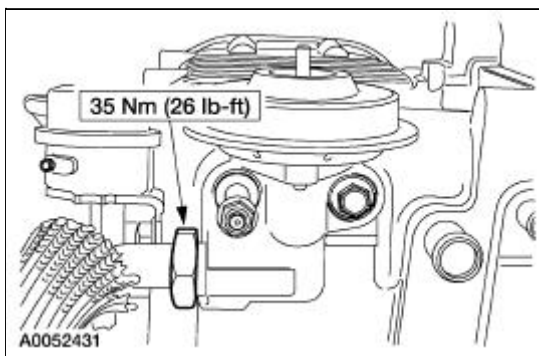
20. Remove the vacuum accessory bracket mounting nut.



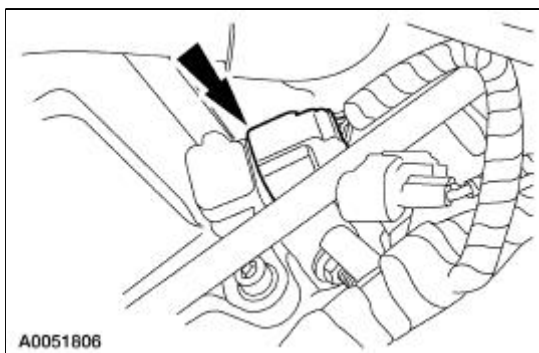
21. Remove the mounting bolts and the vacuum accessory bracket.



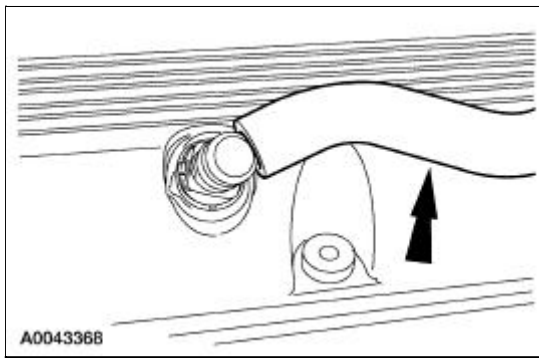
22. Disconnect the exhaust manifold to EGR valve tube.



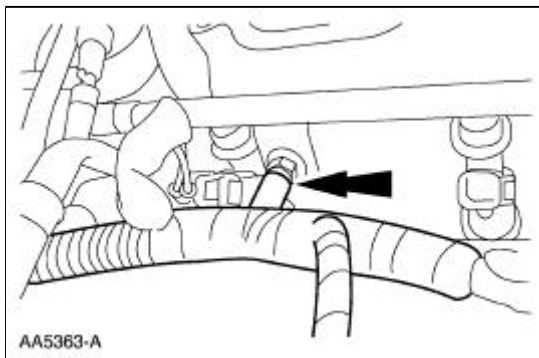
23. Disconnect the barometric pressure (BARO) sensor electrical connector.



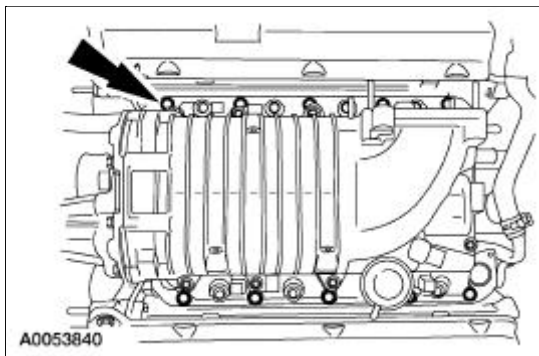
24. Disconnect the positive crankcase ventilation hose.



25. Separate the fuel charging wiring harness from the fuel injection supply manifold in four places and position the harness aside.



26. Remove the ten bolts and the intake manifold, and the supercharger and fuel supply manifold as an assembly.

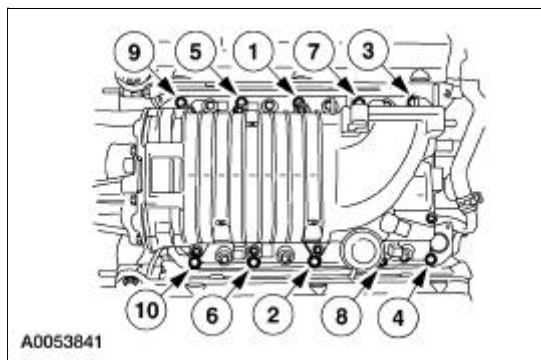


27. **NOTE:** Inspect the intake manifold gaskets and install new gaskets, if necessary.

NOTE: Install new bypass tube O-rings and lubricate them, using premium engine coolant.

To install, reverse the removal procedure.

- Tighten the intake manifold bolts in the sequence shown.



28. Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03A](#) in this section.
 29. Fill and bleed the supercharger cooling system. For additional information, refer to [Section 303-03B](#).
-

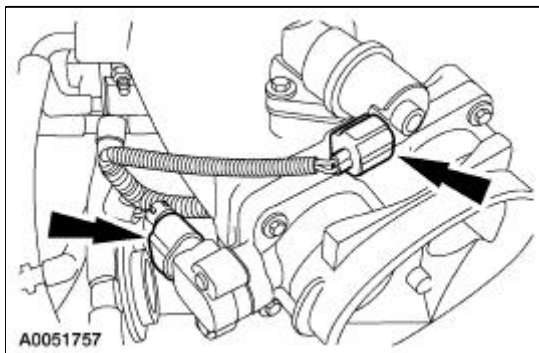
Valve Cover RH

Material

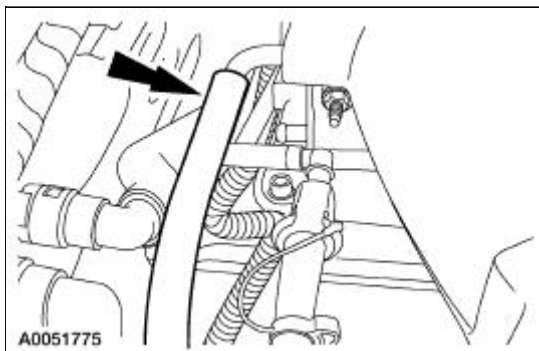
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A

Removal and Installation

1. Remove the RH ignition coils. For additional information, refer to [Section 303-07C](#).
2. Remove the A/C condenser to evaporator tube. For additional information, refer to [Section 412-03](#).
3. Remove the A/C manifold and tube assembly. For additional information, refer to [Section 412-03](#).
4. Disconnect the throttle position (TP) sensor and the idle air control (IAC) valve electrical connectors.

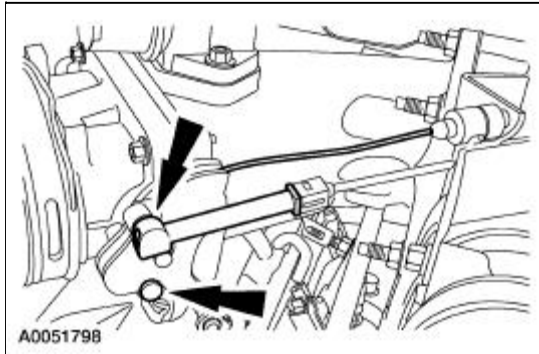


5. Disconnect the vacuum hose.

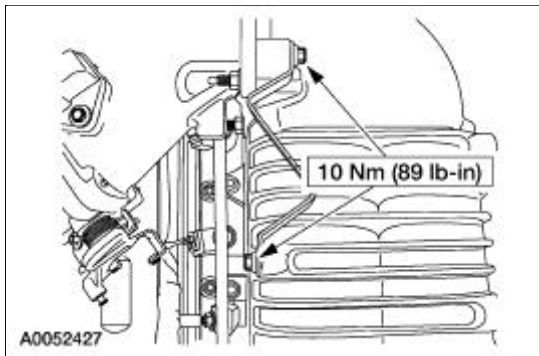


6. Disconnect the fuel hose spring lock coupling. For additional information, refer to [Section 310-00](#).

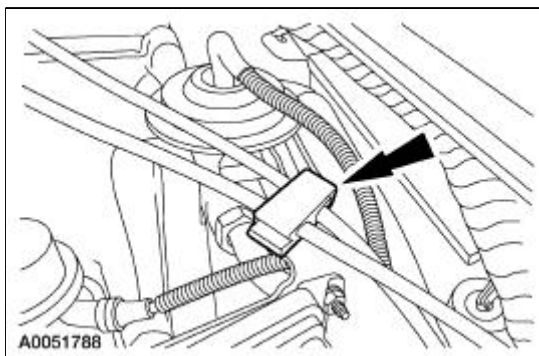
7. Disconnect the accelerator controls.
 - Disconnect the accelerator cable.
 - If equipped, disconnect the speed control cable.



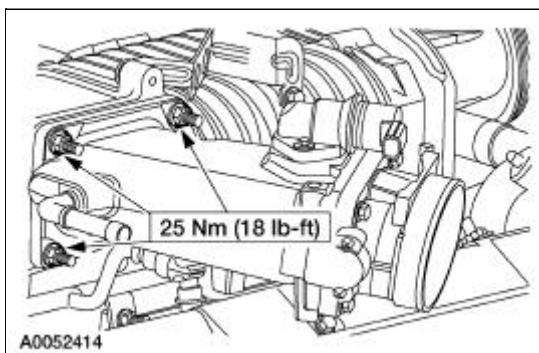
8. Remove the accelerator cable bracket bolts.



9. Release the clip and position the accelerator cable bracket and the cables aside.



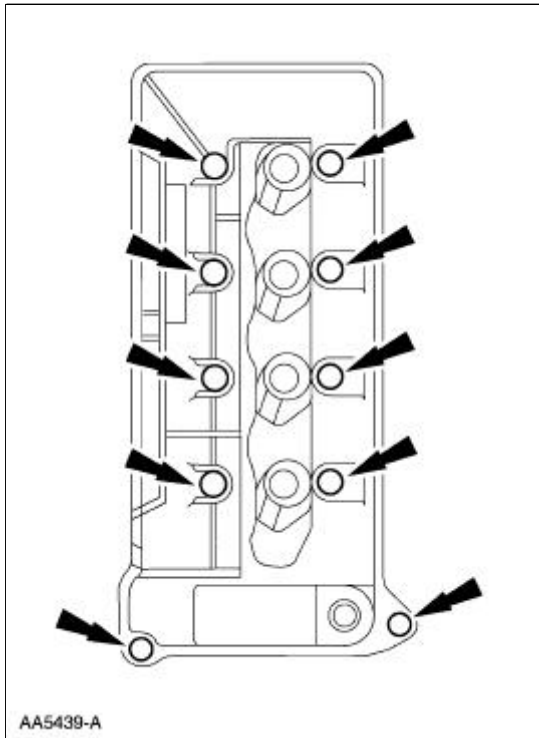
10. Remove the throttle body and spacer assembly.



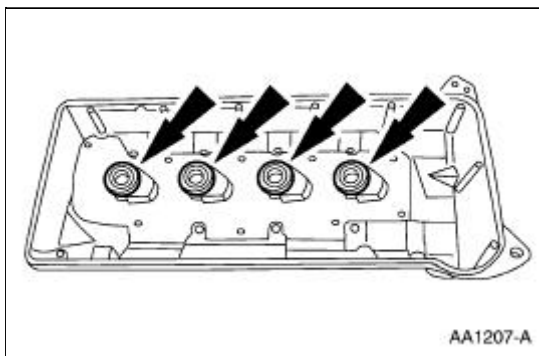
11. Remove the RH valve cover.

-  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Remove and discard the gasket, clean and inspect the sealing surfaces.

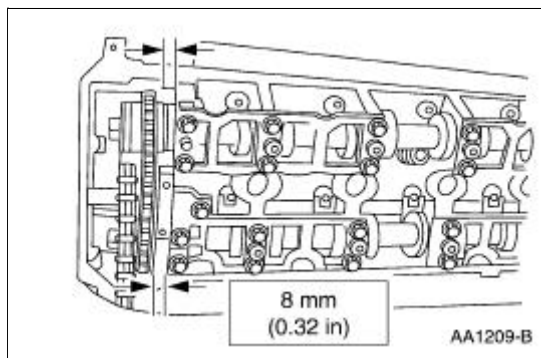


12. Inspect the valve cover spark plug hole gaskets. Install new gaskets, if necessary. Make sure the gaskets are correctly seated on the valve cover.



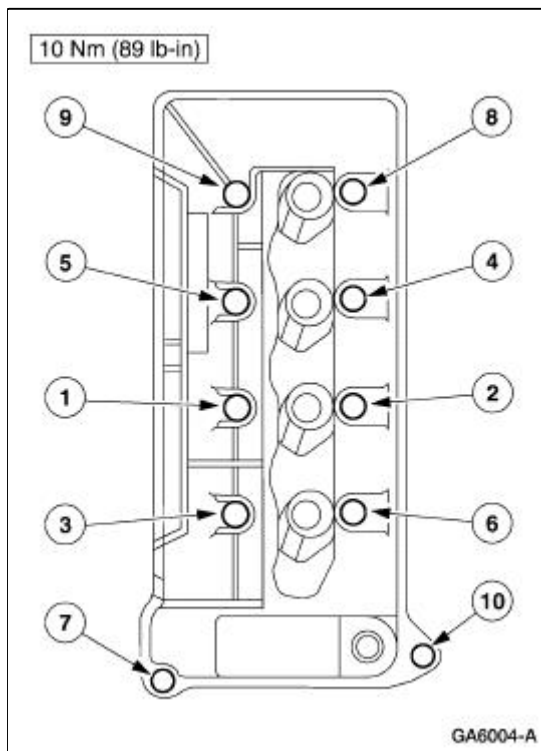
13. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply a bead of silicone gasket and sealant in two places where indicated.



14. To install, reverse the removal procedure.

- Tighten the valve cover bolts in the sequence shown.



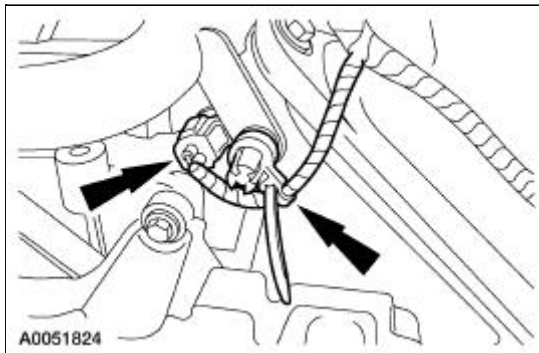
Valve Cover LH

Material

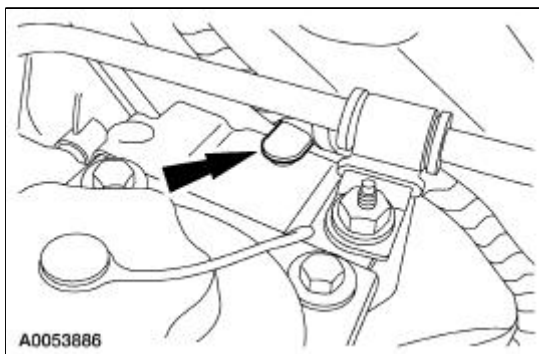
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A

Removal and Installation

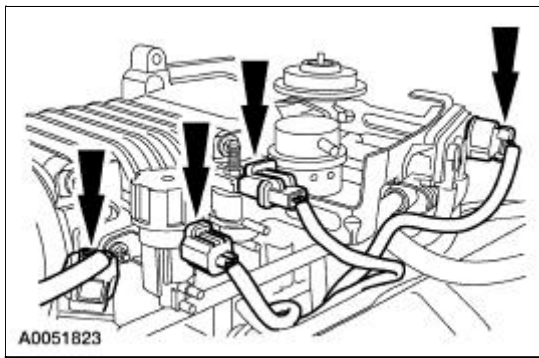
1. Remove the Hydro Boost brake booster. For additional information, refer to [Section 206-07](#).
2. Remove the LH ignition coils. For additional information, refer to [Section 303-07C](#).
3. Disconnect the engine coolant temperature (ECT) sensor and unclip the wiring harness from the stud.



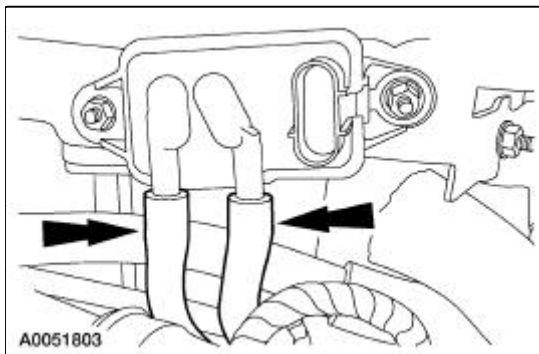
4. Unclip the wiring harness from the power steering bracket.



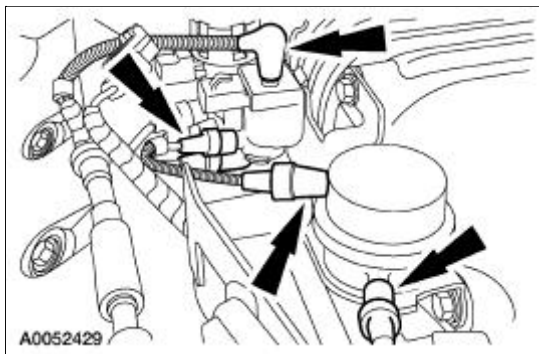
5. Disconnect the electrical connectors from the fuel pulse damper, EGR vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



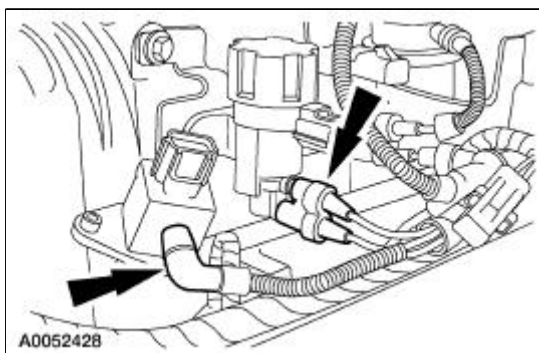
6. Disconnect the vacuum hoses from the differential pressure feedback EGR system.



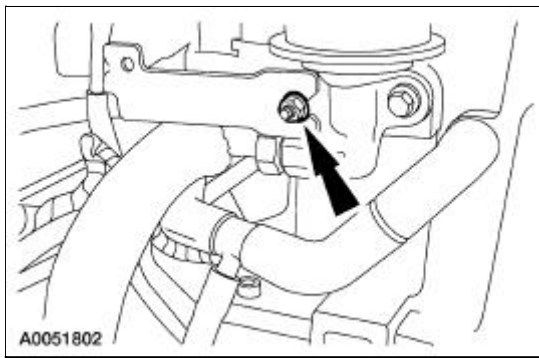
7. Disconnect the vacuum hoses from the supercharger bypass vacuum solenoid and the actuator.



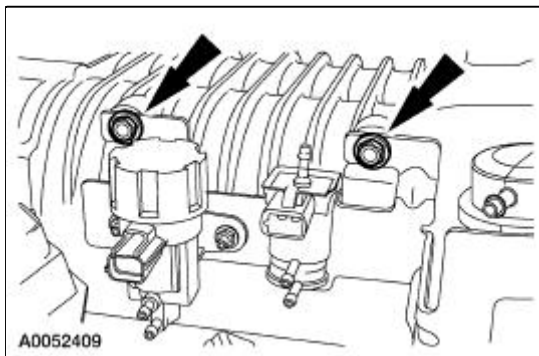
8. Disconnect the vacuum hoses from the fuel pulse damper and the EGR vacuum regulator solenoid, and position the vacuum harness aside.



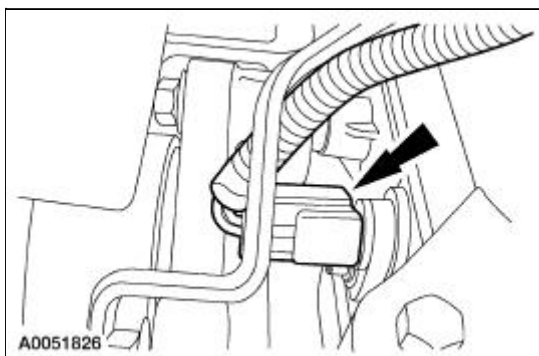
9. Remove the vacuum accessory bracket mounting nut.



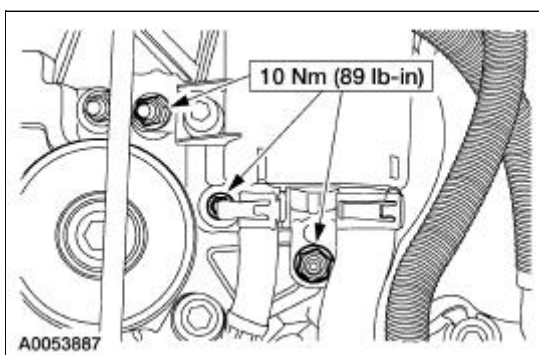
10. Remove the mounting bolts and the vacuum accessory bracket.



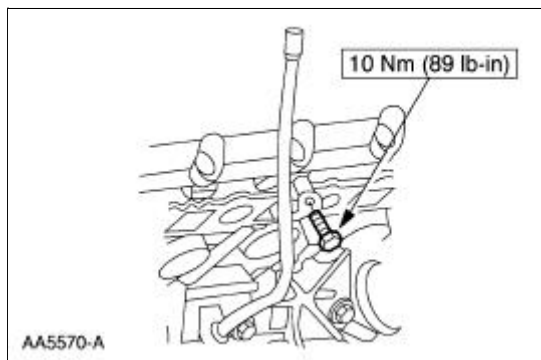
11. Disconnect the camshaft position (CMP) sensor electrical connector.



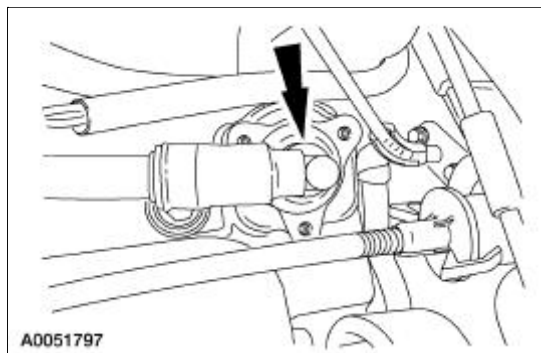
12. Remove the fasteners and position the power steering reservoir aside.



13. Remove the bolt and position the oil level indicator tube aside.



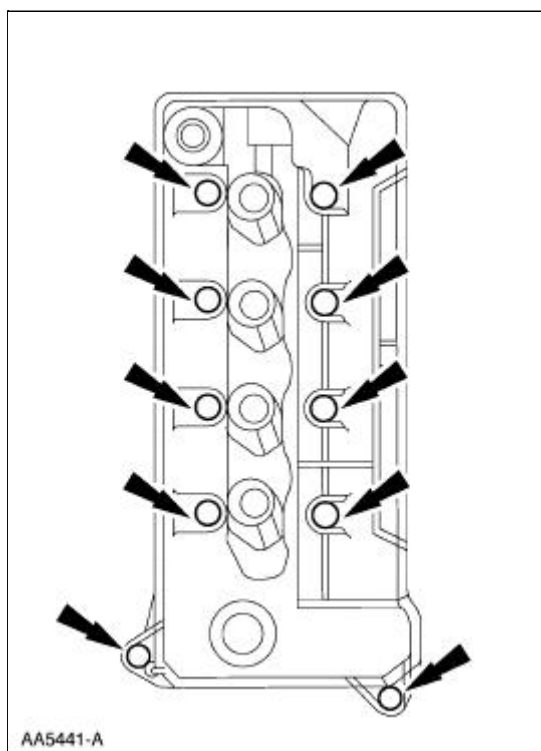
14. Disconnect the positive crankcase ventilation (PCV) valve and position it aside.



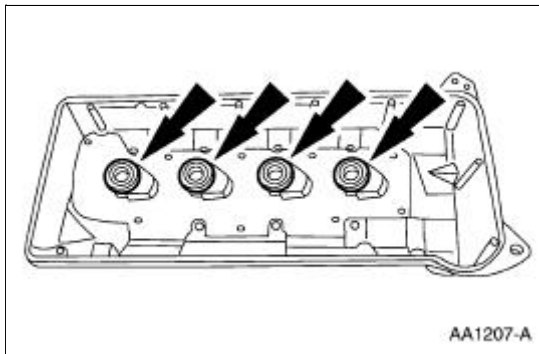
15. **⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

Remove the valve cover.

- Remove and discard the gasket, clean and inspect the sealing surfaces.

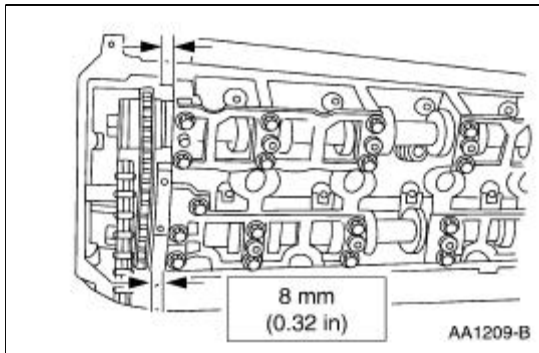


16. Inspect the valve cover spark plug hole gaskets. Install new gaskets, if necessary. Make sure the gaskets are correctly seated on the valve cover.



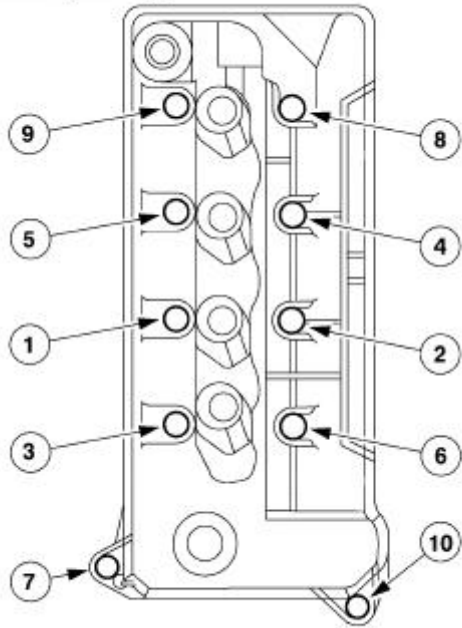
17. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply a bead of silicone gasket and sealant in two places where indicated.



18. To install, reverse the removal procedure.
- Tighten the valve cover in the sequence shown.

10 Nm (89 lb-in)



AA5442-B



Crankshaft Pulley

Special Tool(s)

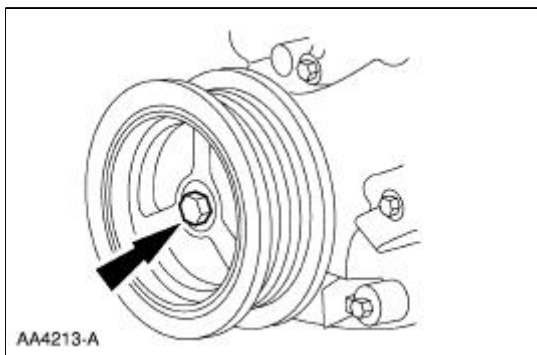
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Material

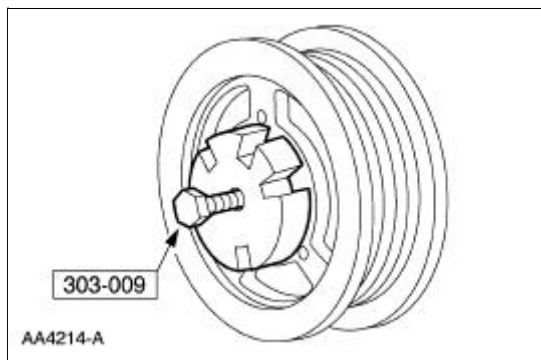
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4

Removal

1. Remove the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
2. Remove the accessory drive belt. For additional information, refer to [Section 303-05](#).
3. Remove the bolt.



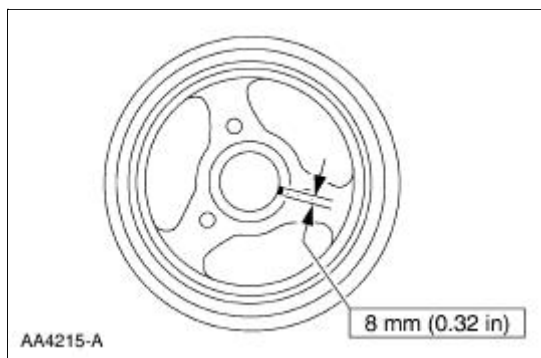
4. Using the special tool, remove the crankshaft pulley.



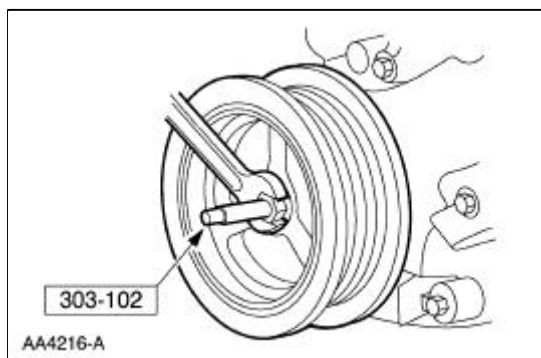
Installation

1. **NOTE:** The crankshaft pulley must be installed within four minutes after applying the silicone.

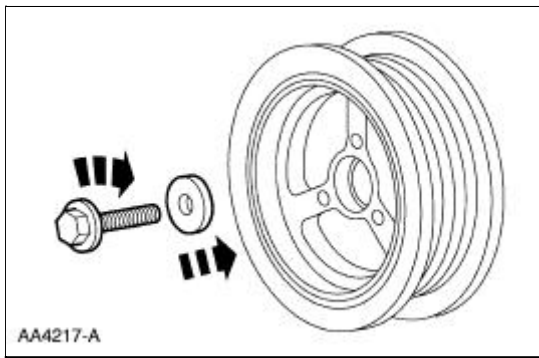
Apply silicone gasket and sealant to the Woodruff key slot on the crankshaft pulley.



2. Using the special tool, install the crankshaft pulley.



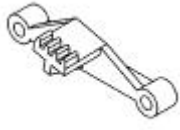
3. Install the bolt and washer. Tighten the bolt in four stages.
 - Stage 1: Tighten the bolt to 90 Nm (66 lb-ft).
 - Stage 2: Loosen the bolt one full turn.
 - Stage 3: Tighten the bolt to 50 Nm (37 lb-ft).
 - Stage 4: Tighten the bolt an additional 85 to 95 degrees.



4. Install the accessory drive belt. For additional information, refer to [Section 303-05](#).
 5. Install the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
-

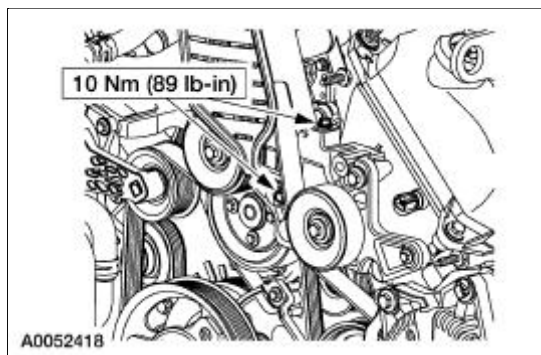
Crankshaft Pulley —Auxiliary

Special Tool(s)

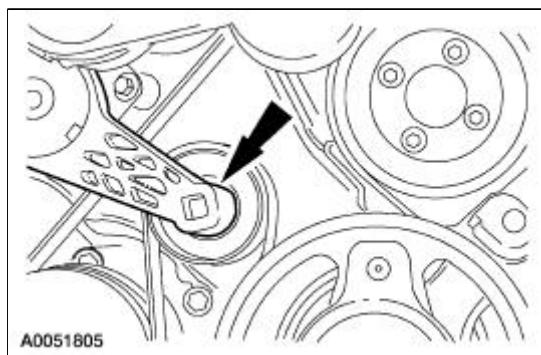
 ST2422-A	Locking Tool, Flywheel 303-673
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Removal and Installation

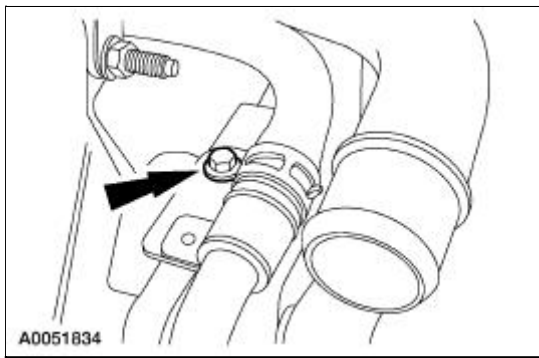
1. Remove the cooling fan. For additional information, refer to [Section 303-03A](#).
2. Remove the supercharger drive belt cover.



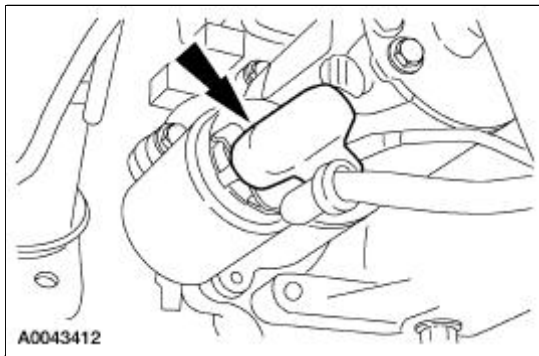
3. Rotate the supercharger belt tensioner clockwise and remove the supercharger belt.



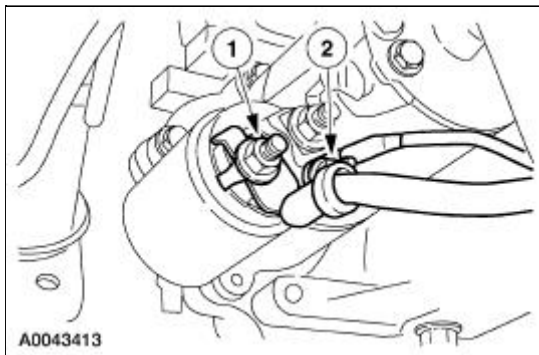
4. Remove the coolant hose assembly bolt.



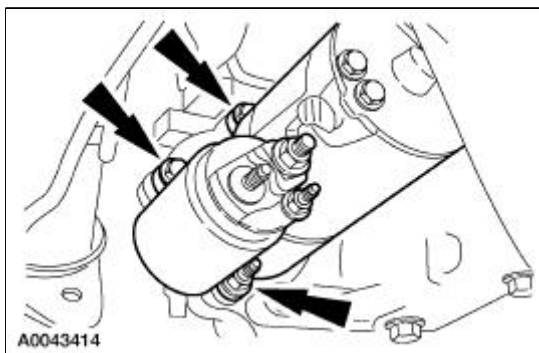
5. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
6. Remove the starter motor terminal cover.



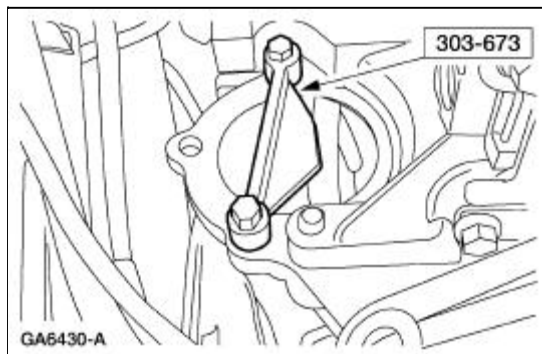
7. Disconnect the starter wiring.
 1. Remove the nut and disconnect the battery positive cable.
 2. Remove the nut and disconnect the starter solenoid wire.



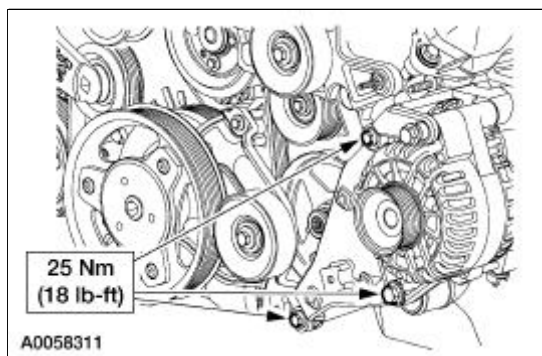
8. Remove the three bolts and the starter.



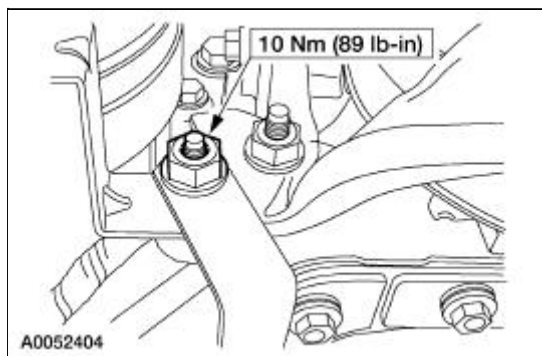
9. Install the special tool.



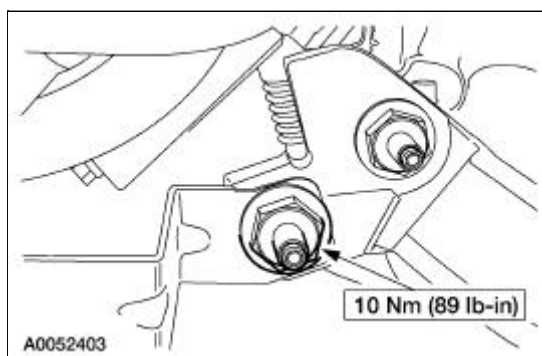
10. Remove the bolts and the alternator support bracket.



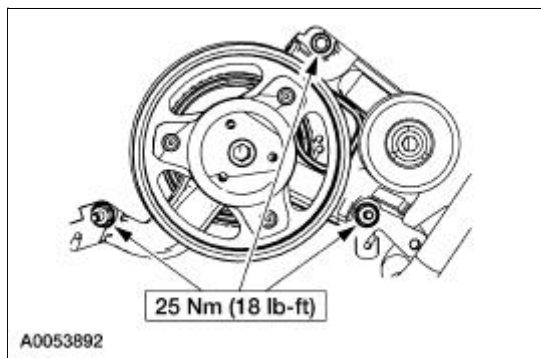
11. Remove the nut and position the wiring harness aside.



12. Remove the stud and position the coolant hose assembly aside.

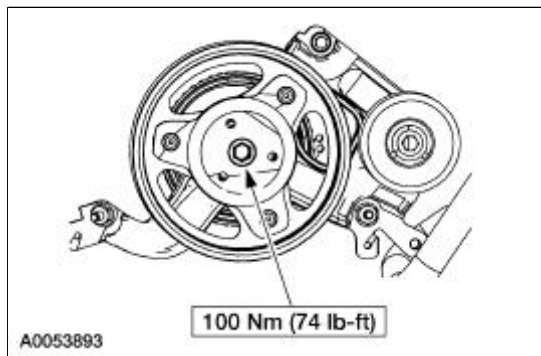


13. Remove the auxiliary crankshaft pulley brace fasteners.



14. **NOTE:** The auxiliary crankshaft pulley is left-hand threaded.

Remove the auxiliary crankshaft pulley and brace assembly.



15. To install, reverse the removal procedure.
-

Crankshaft Front Seal

Special Tool(s)

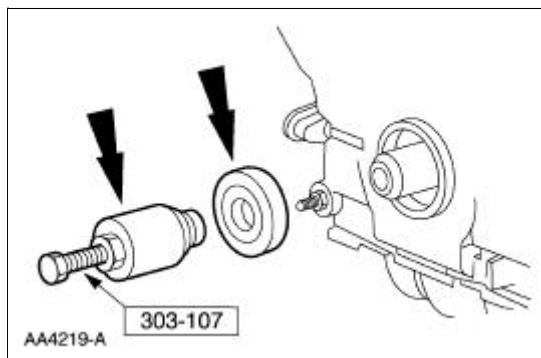
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1288-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)
 ST2197-A	Installer, Crankshaft Front Oil Seal 303-635
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Material

Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

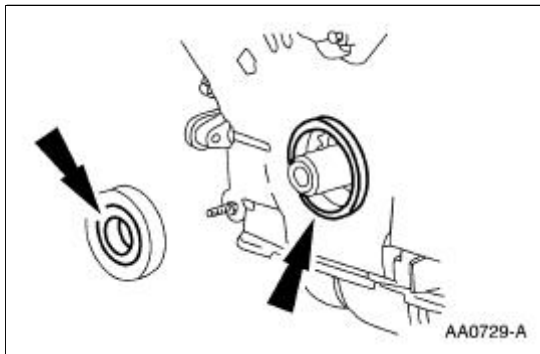
Removal

1. Remove the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
2. Using the special tool, remove the crankshaft front seal.

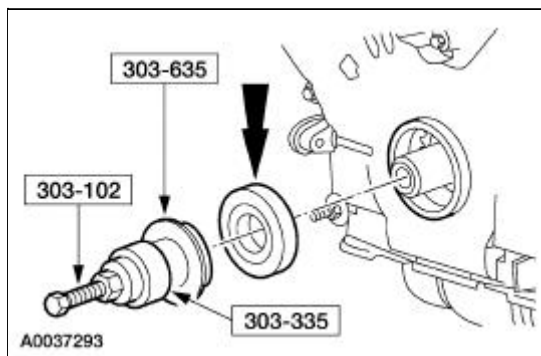


Installation

1. Lubricate the engine front cover and the crankshaft front seal inner lip with clean engine oil.



2. Using the special tool, install the crankshaft front seal.



3. Install the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
 4. Install the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
-

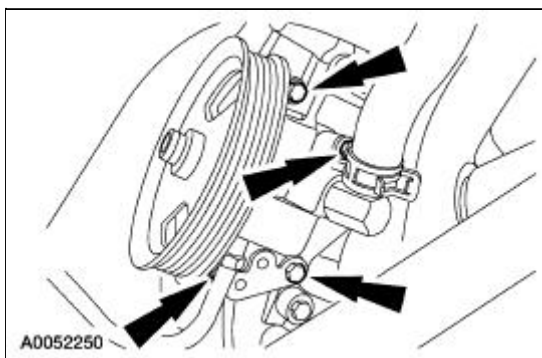
Engine Front Cover

Material

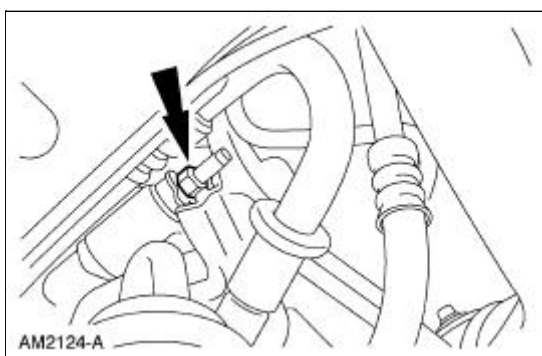
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

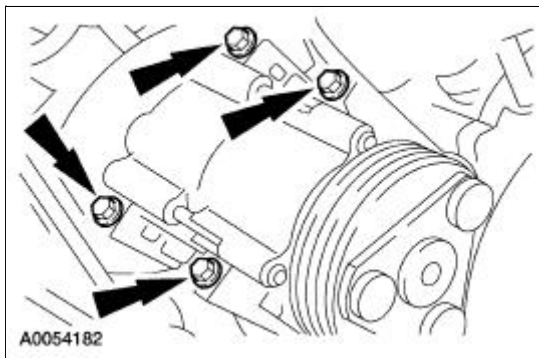
1. Remove the crankshaft front seal. For additional information, refer to [Crankshaft Front Seal](#) in this section.
2. Remove the oil filter adapter. For additional information, refer to [Oil Filter Adapter](#) in this section.
3. Remove the three bolts shown. Loosen the fourth bolt (hidden below the power steering tube) and position the power steering pump aside.



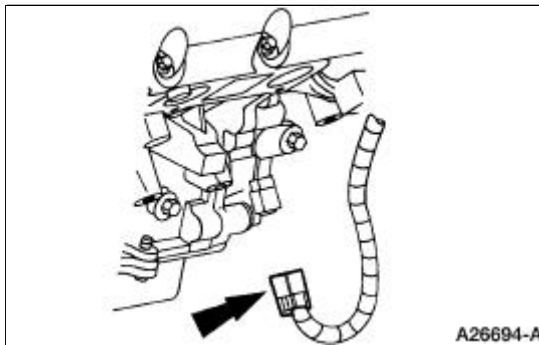
4. Remove the A/C muffler bracket nut.



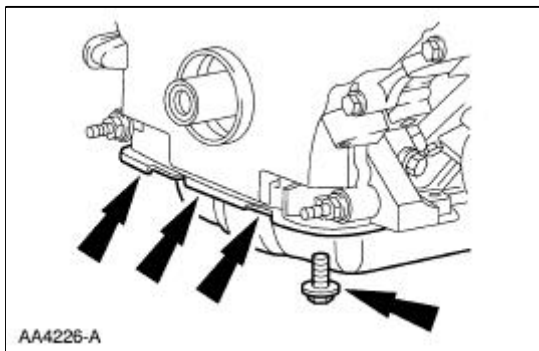
5. Remove the bolts and position the A/C compressor aside.



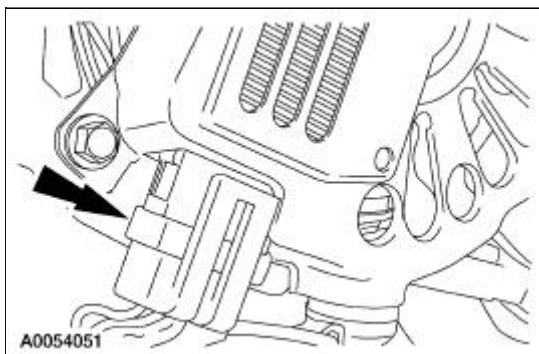
6. Disconnect the crankshaft position sensor.



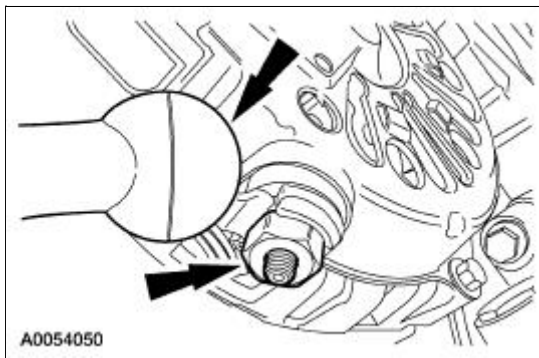
7. Remove the four front bolts.



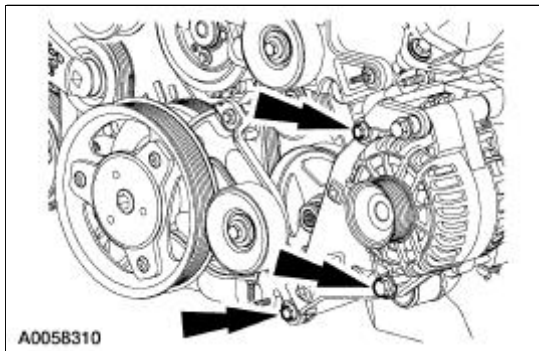
8. Disconnect the generator electrical connector.



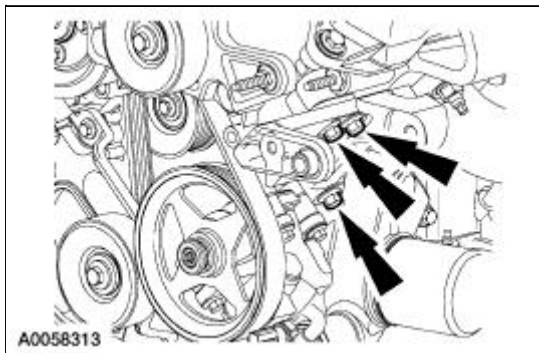
9. Remove the generator B+ terminal nut and detach the B+ cable.



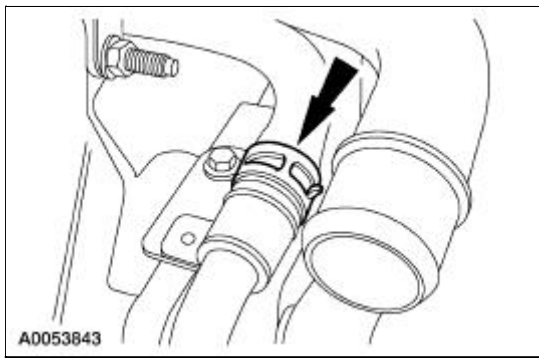
10. Remove the bolts and the generator.



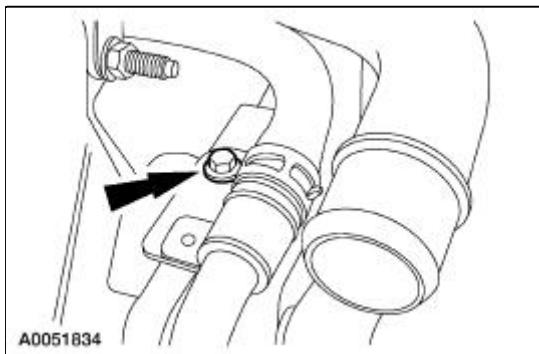
11. Remove the generator support bracket.



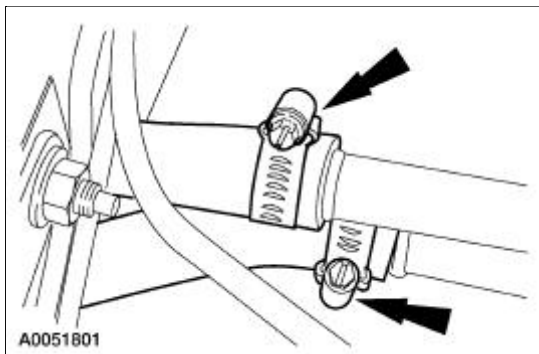
12. Drain the engine coolant and the supercharger coolant. For additional information, refer to [Section 303-03A](#) and [Section 303-03B](#).
13. Lower the vehicle.
14. Remove the coolant bypass tube. For additional information, refer to [Section 303-03A](#).
15. Remove the left and right valve covers. For additional information, refer to [Valve Cover LH](#) and [Valve Cover RH](#) in this section.
16. Disconnect the supercharger coolant hose.



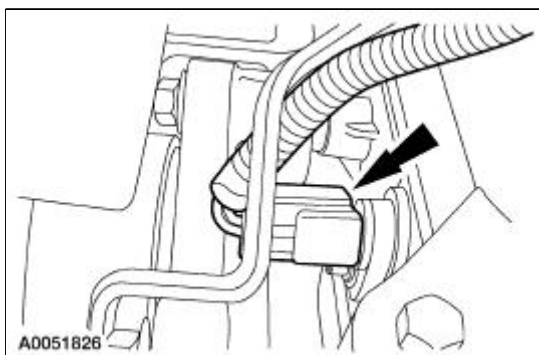
17. Remove the coolant hose mounting bolt.



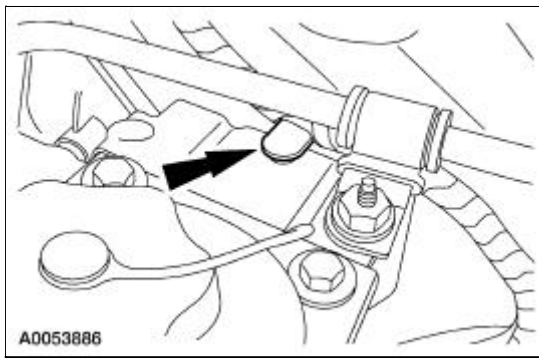
18. Disconnect the supercharger coolant hoses and remove the supercharger hose and tube assembly.



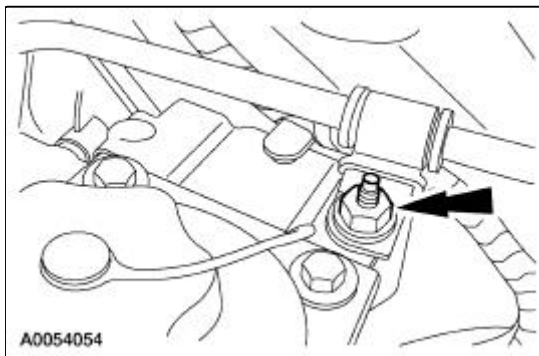
19. Disconnect the camshaft position (CMP) sensor electrical connector.



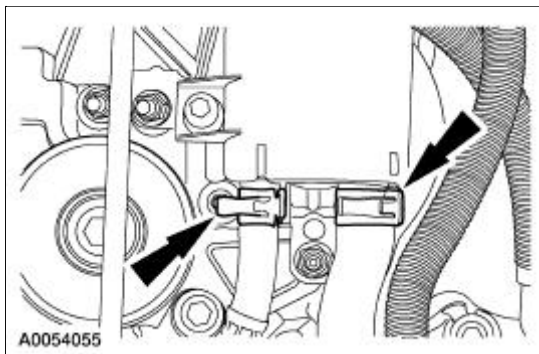
20. Unclip the wiring harness from the power steering bracket.



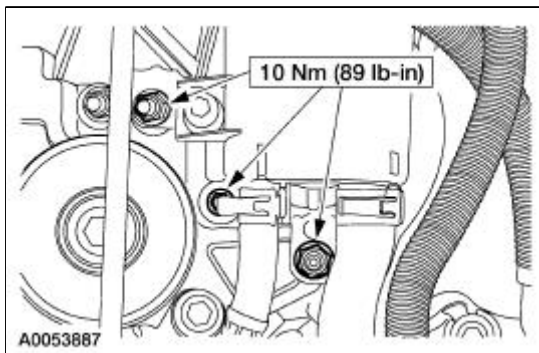
21. Remove the nut.



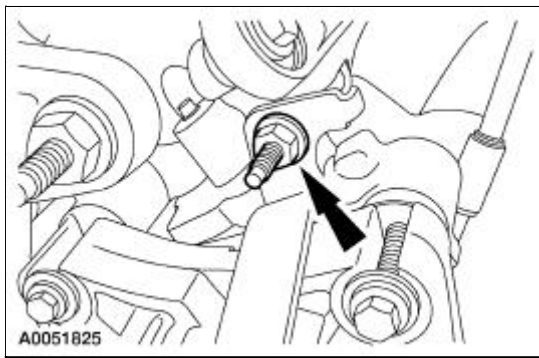
22. Disconnect the power steering hoses and drain the power steering fluid into a suitable container.



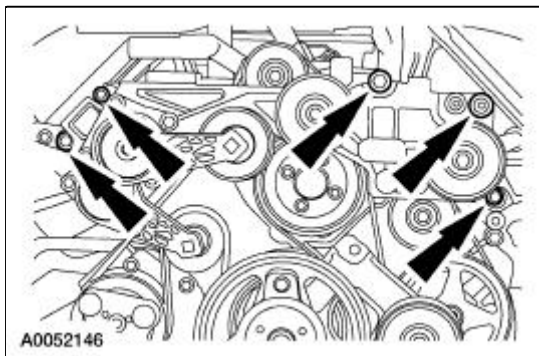
23. Remove the fasteners and the power steering reservoir.



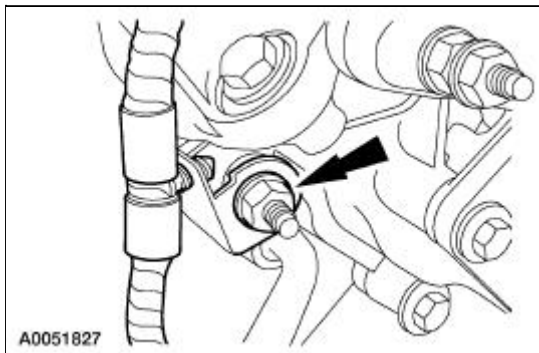
24. Remove the nut and the position the power steering hose aside.



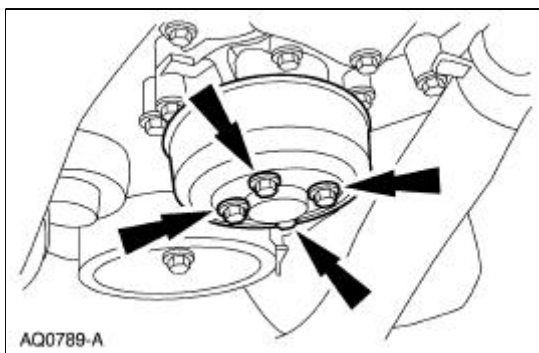
25. Remove the fasteners and the supercharger belt idler support bracket assembly.



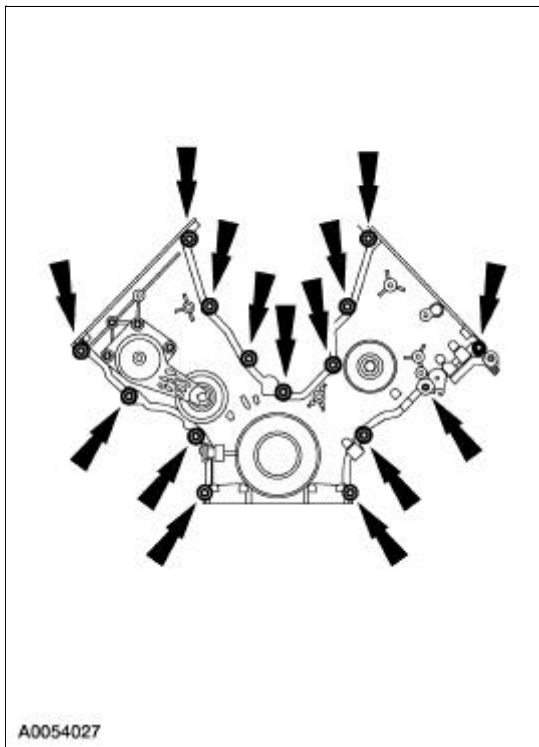
26. Remove the wiring harness bracket.



27. Remove the water pump pulley.



28. Remove the bolts, the studs and the engine front cover.



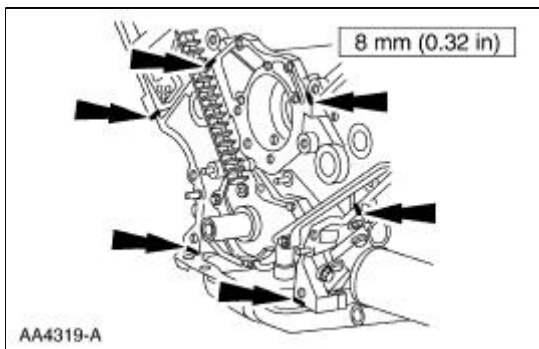
29.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Remove and discard the gasket, clean and inspect the sealing surfaces.

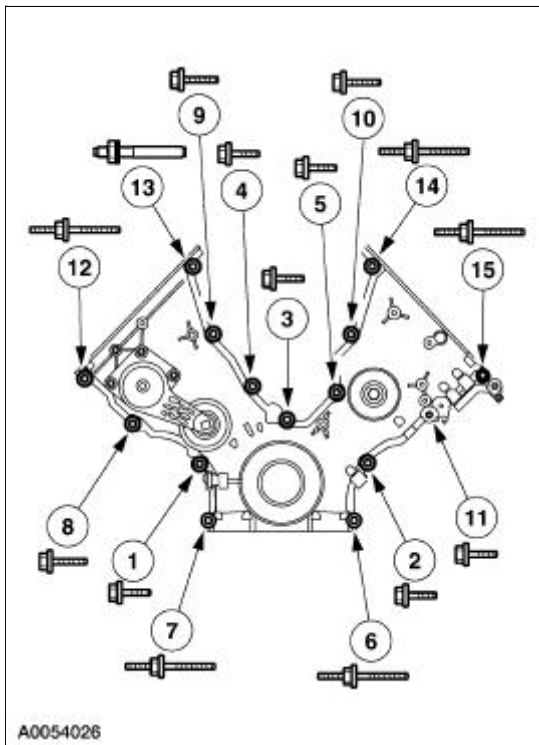
Installation

1. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant in the locations shown.

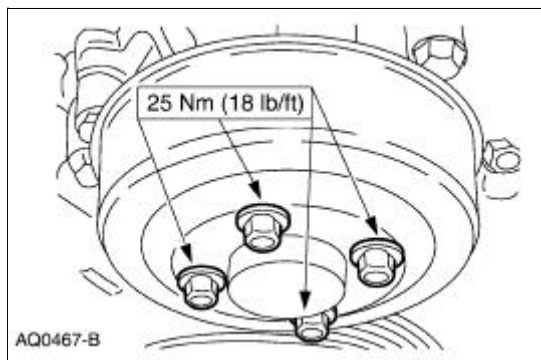


2. Install the engine front cover and tighten the fasteners in the sequence shown, to 25 Nm (18 lb-in).

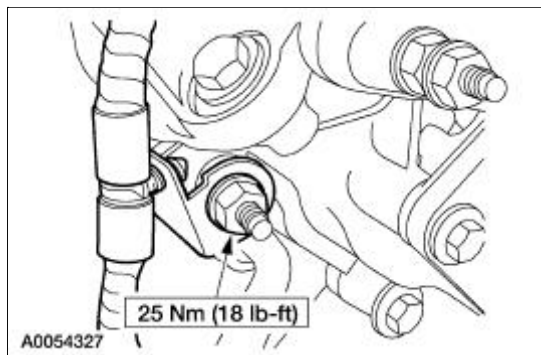


Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
7	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
12	W706560	Stud, Hex Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1

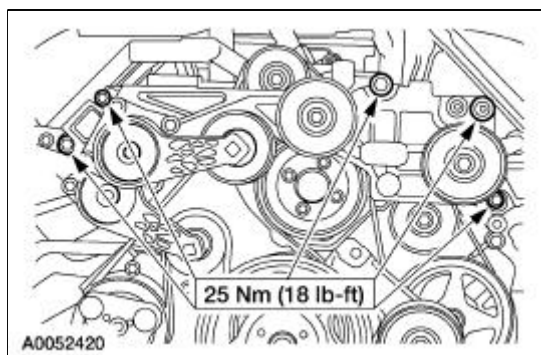
3. Install the water pump pulley.



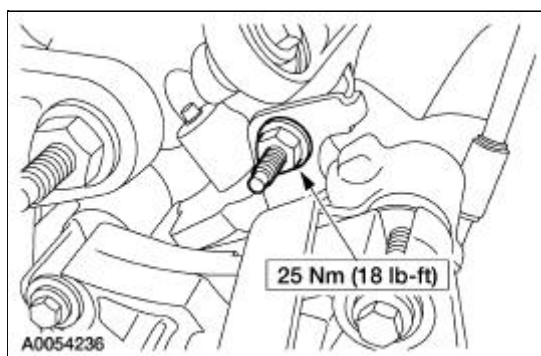
4. Install the wiring harness bracket and the nut.



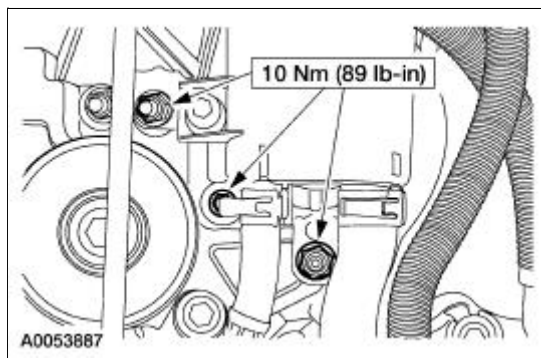
5. Install the supercharger belt idler support bracket assembly and fasteners.



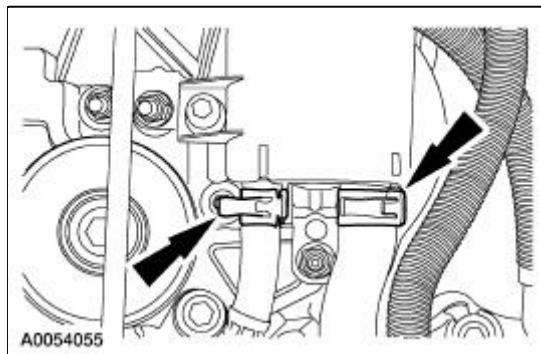
6. Install the power steering hose bracket nut.



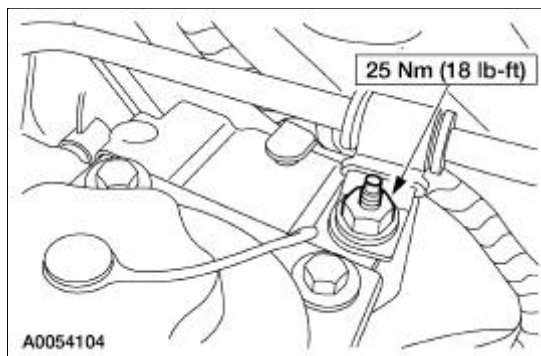
7. Install the power steering reservoir and the fasteners.



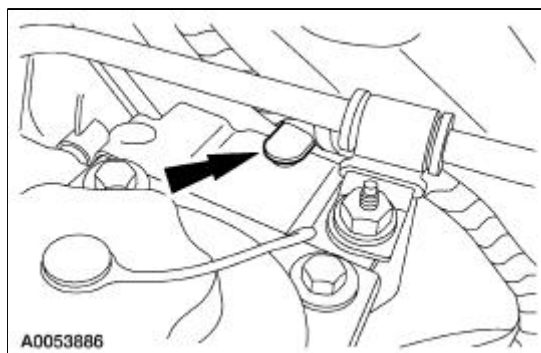
8. Connect the power steering hoses.



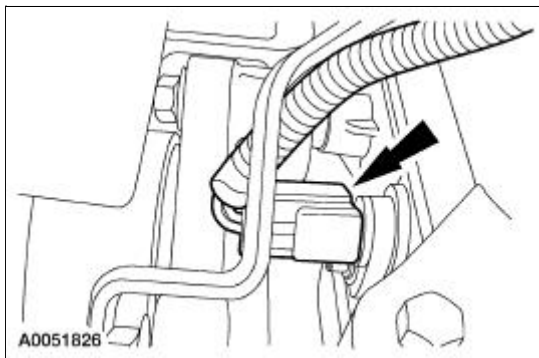
9. Install the power steering hose nut.



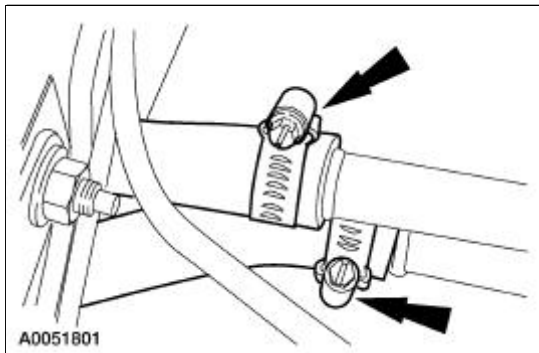
10. Attach the wiring harness to the power steering bracket.



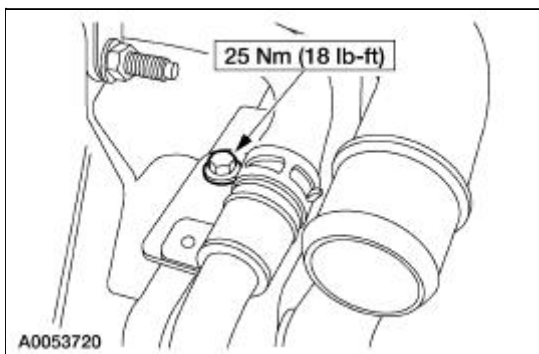
11. Connect the camshaft position (CMP) sensor electrical connector.



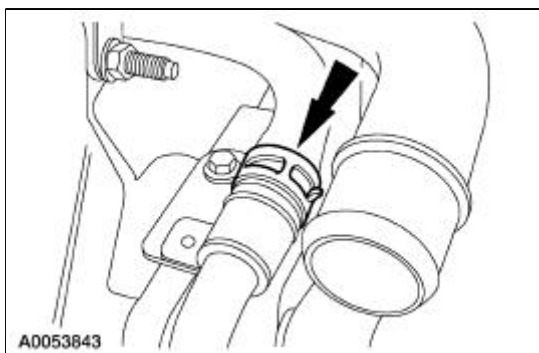
12. Install the supercharger hose and tube assembly, and connect the coolant hoses.



13. Install the coolant hose mounting bolt.

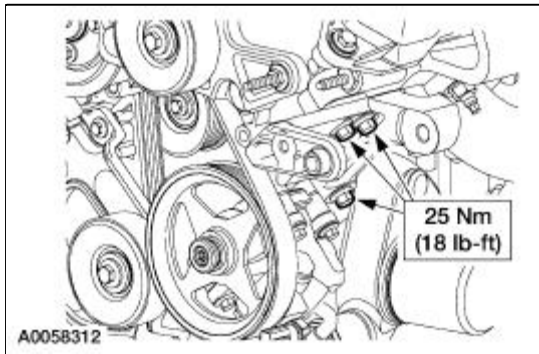


14. Connect the supercharger coolant hose.

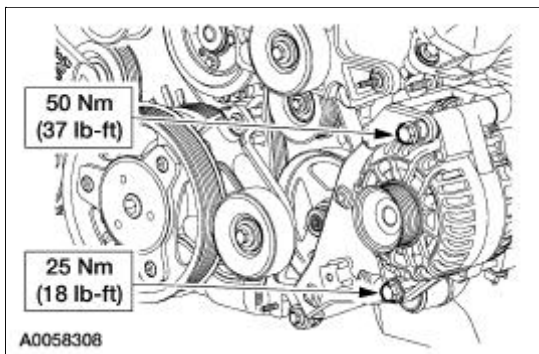


15. Install the left and right valve covers. For additional information, refer to [Valve Cover LH](#) and [Valve Cover RH](#) in this section.
16. Install the coolant bypass tube. For additional information, refer to [Section 303-03A](#).

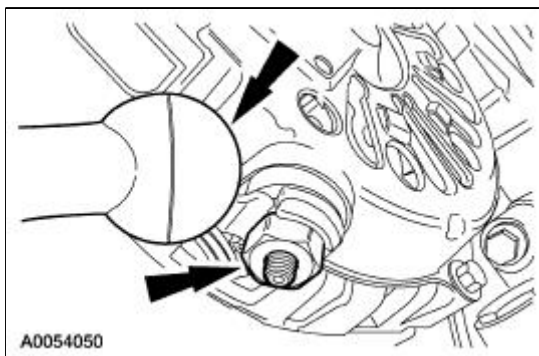
17. Raise the vehicle.
18. Install the generator support bracket.



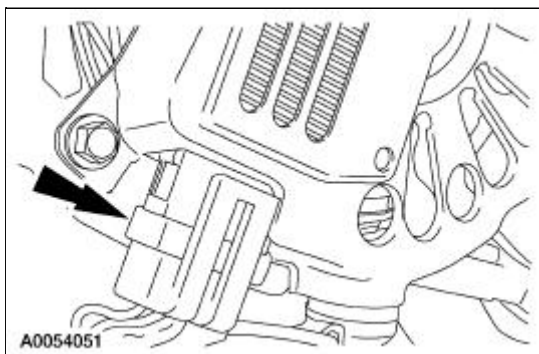
19. Install the generator and the bolts.



20. Attach the B + cable and install the generator B + terminal nut.

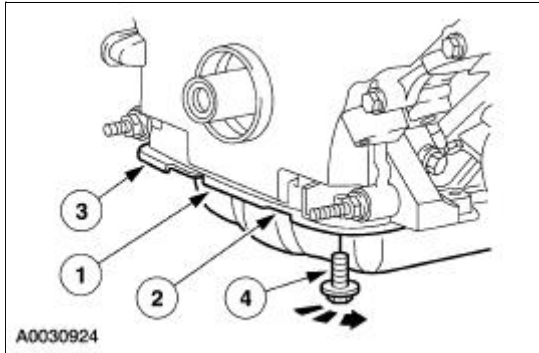


21. Connect the generator electrical connector.

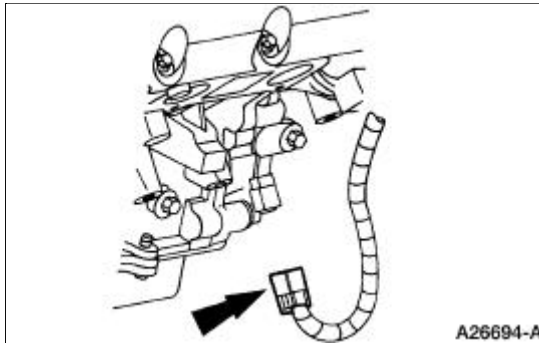


22. Tighten the bolts in three stages, in the sequence shown.

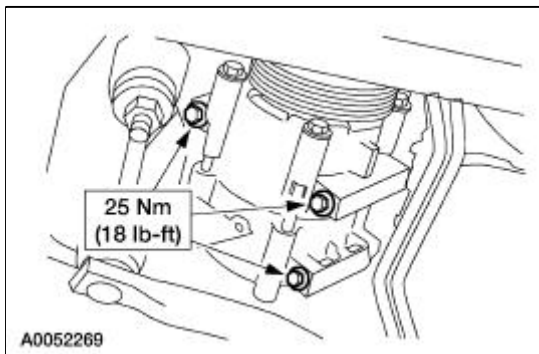
- Stage 1: Tighten to 2 Nm (18 lb-in).
- Stage 2: Tighten to 20 Nm (15 lb-ft).
- Stage 3: Tighten an additional 60 degrees.



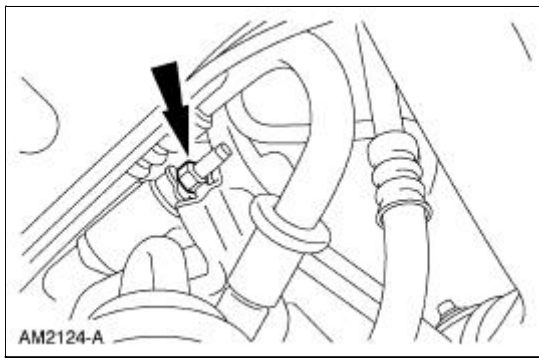
23. Connect the crankshaft position sensor electrical connector.



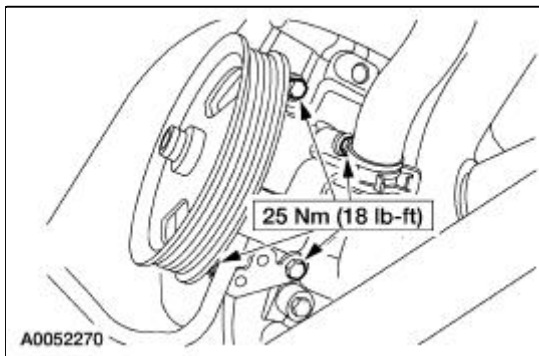
24. Position the A/C compressor and install the bolts.



25. Install the A/C muffler bracket nut.



26. Position the power steering pump and install the bolts.



27. Install the oil filter adapter. For additional information, refer to [Oil Filter Adapter](#) in this section.
 28. Install the crankshaft front seal. For additional information, refer to [Crankshaft Front Seal](#) in this section.
 29. Fill and bleed the engine coolant and the supercharger coolant. For additional information, refer to [Section 303-03A](#) and [Section 303-03B](#).
 30. Fill the crankcase with clean engine oil.
-

Timing Drive Components

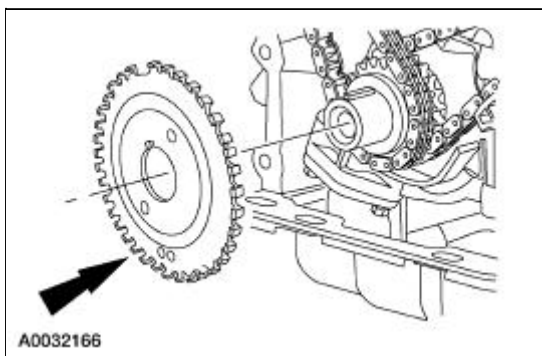
Special Tool(s)



Removal

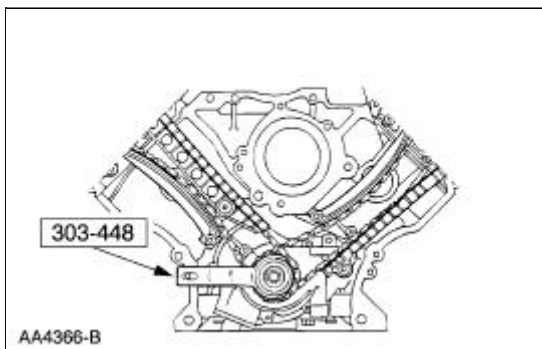
⚠ CAUTION: Since the engine is not free-wheeling, if the crankshaft (6303) or the camshafts (6250) are moved in any manner during removal and installation, the crankshaft and the camshafts must be resynchronized.

1. Remove the engine front cover (6019). For additional information, refer to [Engine Front Cover](#) in this section.
2. Remove the crankshaft sensor ring from the crankshaft.



3. **⚠ CAUTION:** Unless otherwise instructed, at no time when the timing chains (6268) are removed and the cylinder heads (6049) are installed is the crankshaft (6303) or the camshaft (6250) to be rotated. Severe piston (6108) and valve damage will occur.

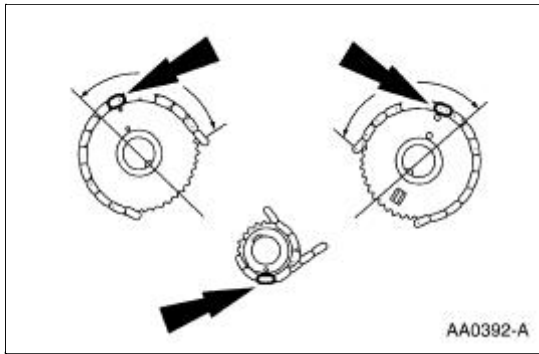
Using the special tool, position the crankshaft as shown.



4.  **CAUTION:** The camshaft timing marks must be correctly lined up or damage to the valves and pistons can occur.

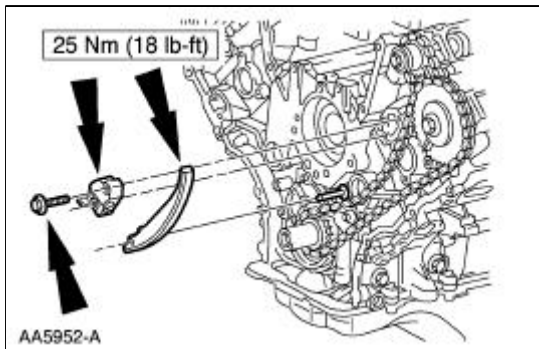
NOTE: The copper links on the timing chain may not line up with the timing marks on the sprockets.

Make sure the timing marks on the camshaft sprockets are correctly positioned. If necessary, turn the crankshaft one full turn clockwise to correctly position the sprockets.



5. **NOTE:** LH shown; RH similar.

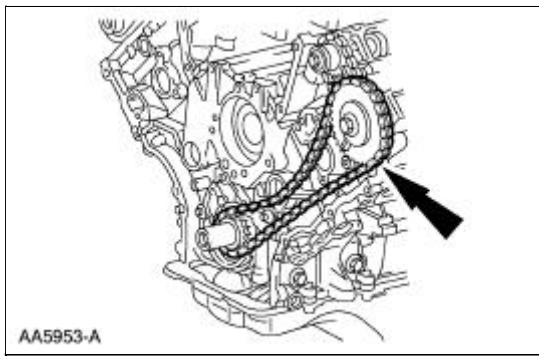
Remove the two bolts, the timing chain tensioner (6L266) and tensioner arm (6L253).



6.  **CAUTION:** Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.

Remove the LH and RH timing chains and the crankshaft sprocket (6306).

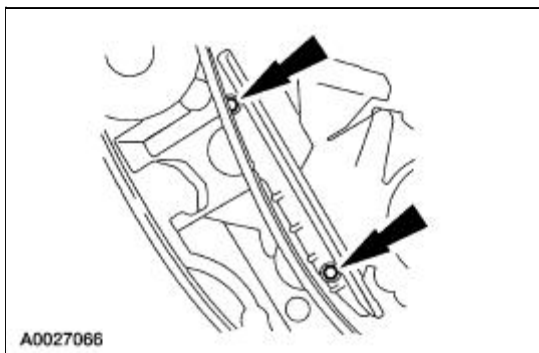
- Remove the special tool from the crankshaft.
- Remove the RH timing chain from camshaft sprocket.
- Remove the RH timing chain from the crankshaft sprocket.
- Remove the LH timing chain from the camshaft sprocket.
- Remove the LH timing chain and crankshaft sprocket.



7. **⚠ CAUTION:** The bolts are different lengths and must be returned to their original location.

NOTE: RH shown; LH similar.

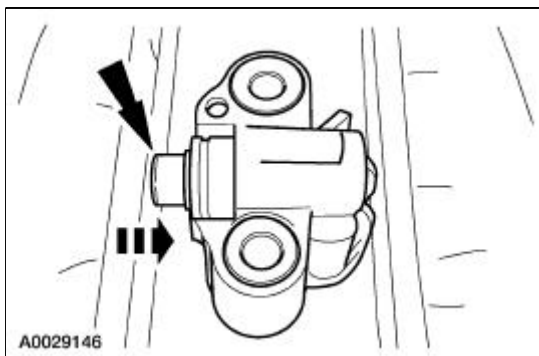
Remove the bolts and the timing chain guides (6K297).



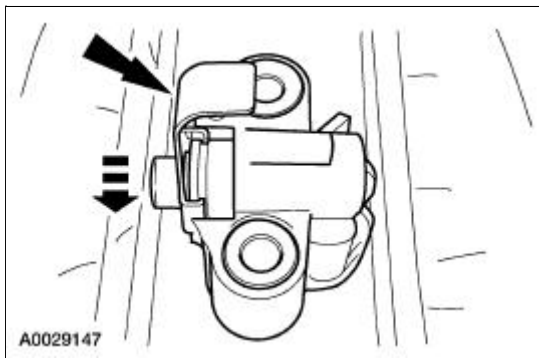
Installation

1. **⚠ CAUTION:** Timing chain procedures must be followed exactly or damage to the pistons or valves will result.

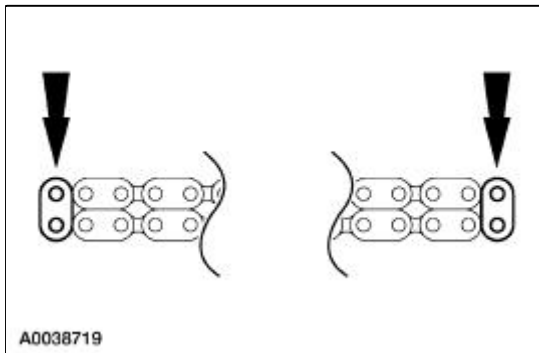
Compress the tensioner plunger, using a soft-jawed vise.



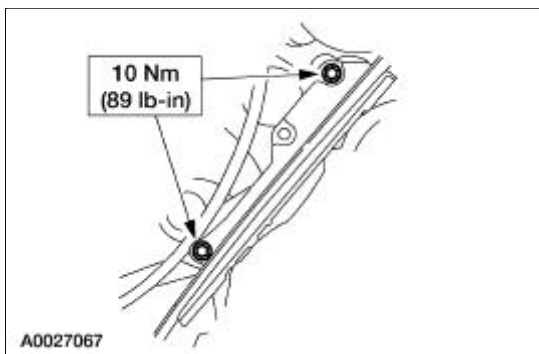
2. Install a retaining clip on the tensioner to hold the plunger in during installation.
- Remove the tensioner from the vise.



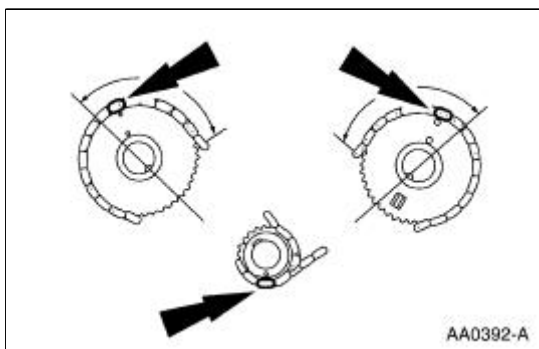
3. If the copper links are not visible, mark one link on one end and one link on the other end, and use as timing marks.



4. Install the timing chain guides.



5. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o' clock position. Rotate the RH camshaft timing sprocket until the timing mark is approximately in the 11 o' clock position.



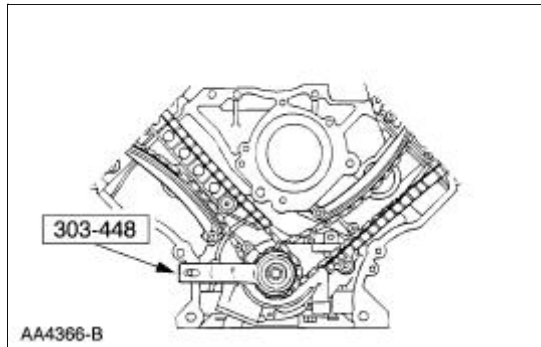
6.  **CAUTION:** Unless otherwise instructed, at no time when the timing chains are

removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.

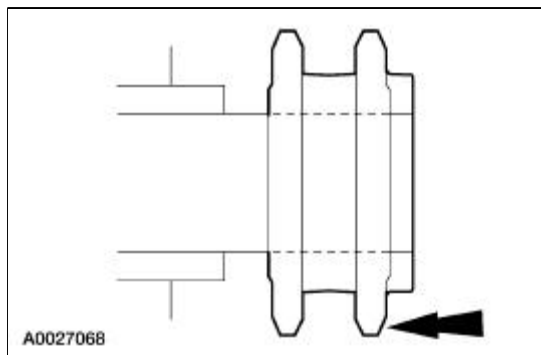


CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston or valve damage will occur.

Using the special tool, position the crankshaft.

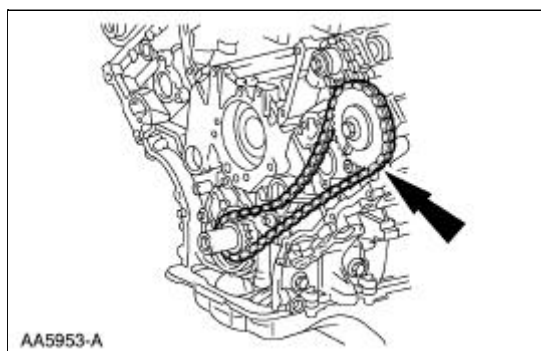


7. Remove the special tool.
8. Install the crankshaft sprocket with the flange facing forward.

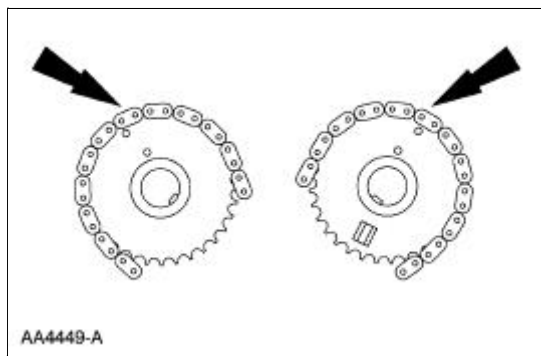


9. **NOTE:** LH timing chain shown; RH similar.

Install the LH timing chain onto the crankshaft sprocket, aligning the one copper link on the timing chain (6268) with the slot on the crankshaft sprocket.

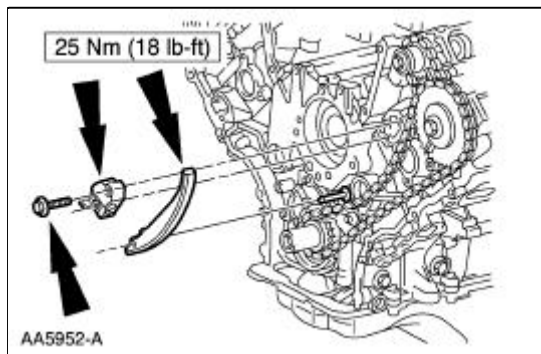


10. Verify the camshaft sprocket to copper link alignment.

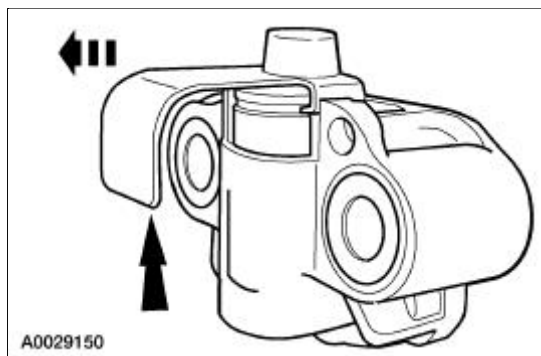


11. **NOTE:** LH shown; RH similar.

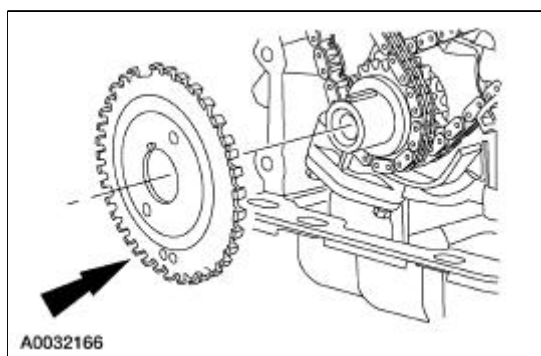
Position the tensioner arms and tensioners, and install the bolts.



12. Remove the retaining clips from the timing chain tensioners.



13. Position the crankshaft sensor ring on the crankshaft.

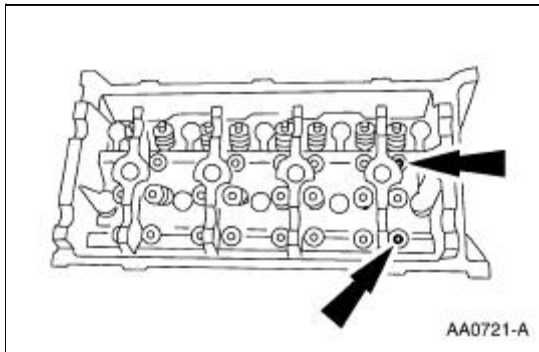


14. Install the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.

Hydraulic Lash Adjusters

Removal

1. Remove the roller followers. For additional information, refer to [Camshaft Roller Follower](#) in this section.
2. Remove the 16 hydraulic lash adjusters.



3. Inspect the roller followers. For additional information, refer to [Section 303-00](#).

Installation

1. To install, reverse the removal procedure.

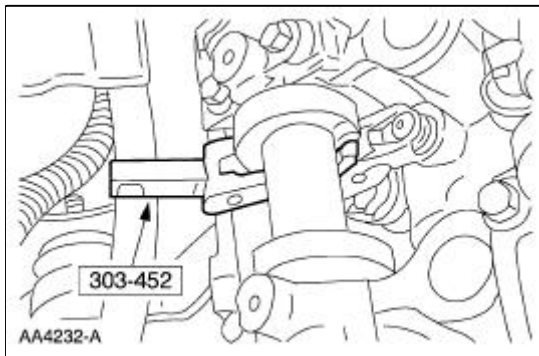
Camshaft Roller Follower

Special Tool(s)

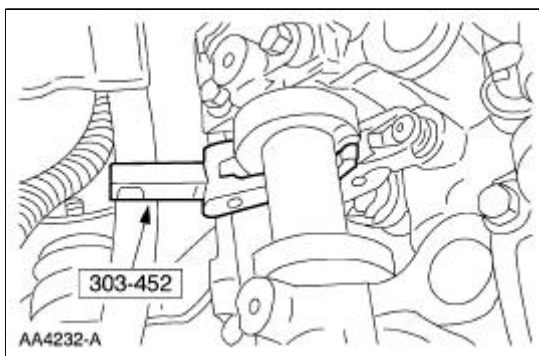


Removal and Installation

1. Remove the left and right valve cover (6582). For additional information, refer to [Valve Cover LH](#) and [Valve Cover RH](#) in this section.
2. Position the piston of the cylinder being repaired at the bottom of the stroke and camshaft lobe at base circle.
3. Using the special tool, compress the intake valve spring and remove the roller follower.



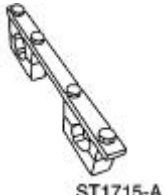
4. Using the special tool, compress the exhaust valve spring and remove the roller follower.



5. Repeat Steps 2, 3 and 4 to remove all the necessary roller followers. Inspect roller finger followers and camshafts. For additional information, refer to [Section 303-00](#).
6. To install, reverse the removal procedure.

Camshaft

Special Tool(s)

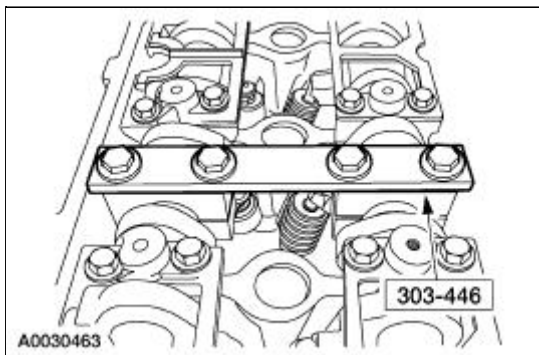
 ST1715-A	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)
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Material

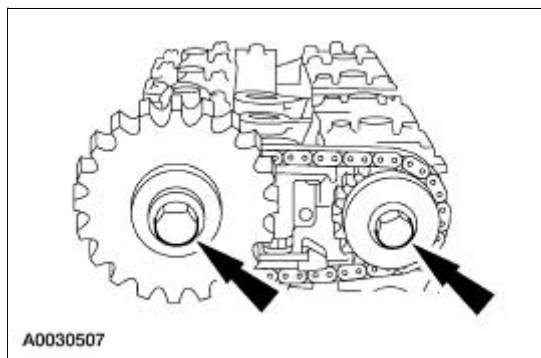
Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153- H

Removal

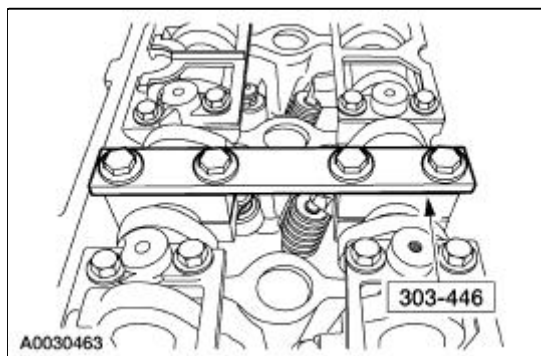
1. Remove the roller followers. For additional information, refer to [Camshaft Roller Follower](#) in this section.
2. Remove the LH timing chain (6268) for the LH side and both timing chains for the RH side. For additional information, refer to [Timing Drive Components](#) in this section.
3. Install the special tool.



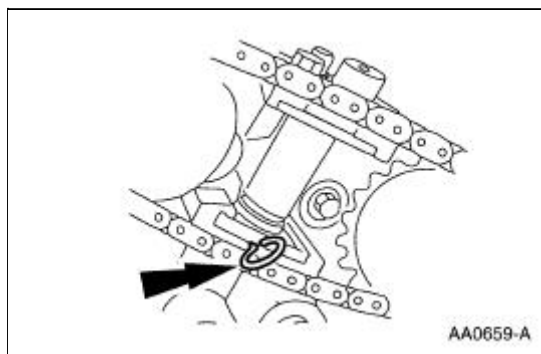
4. Remove the exhaust camshaft sprocket (6250) and the intake camshaft bolt, washer and spacer.



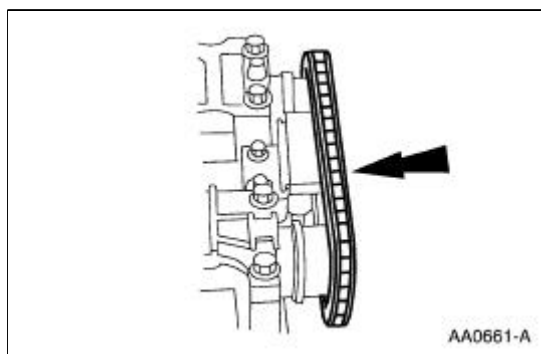
5. Remove the special tool.



6. Compress the tensioner (6L266) and install a lock pin.

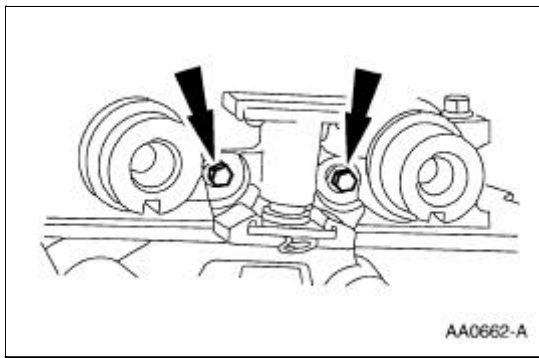


7. Remove the timing chain, the sprocket, and intake camshaft sprocket spacer.



8. **NOTE:** LH shown; RH similar.

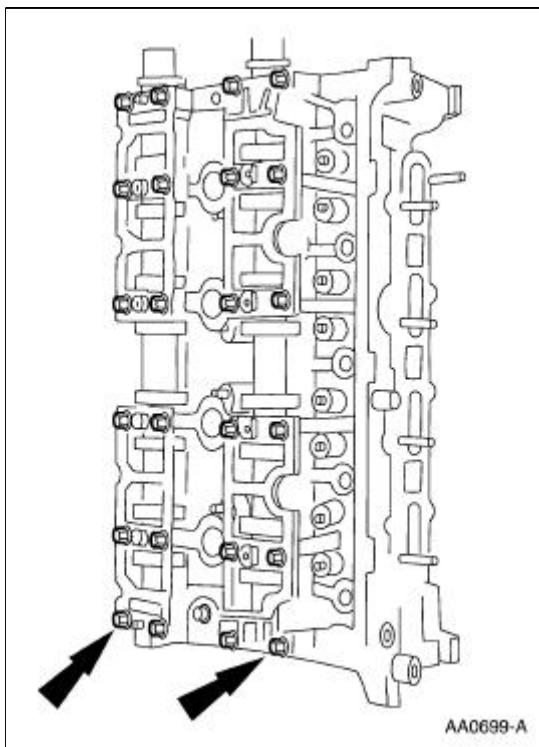
Remove the bolts.



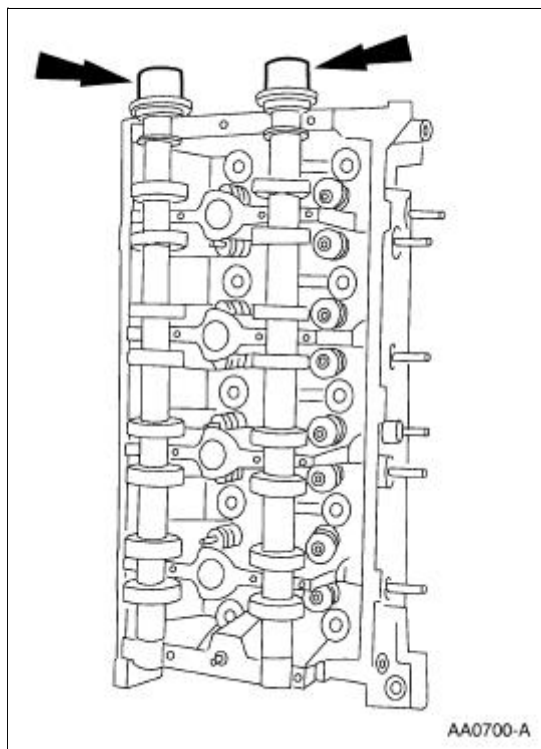
9.  **CAUTION:** The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.

NOTE: Identify the camshaft to cylinder head location. Caps are not interchangeable.

Remove the bolts and the camshaft bearing cap assemblies.



10. Remove the camshafts (6250).

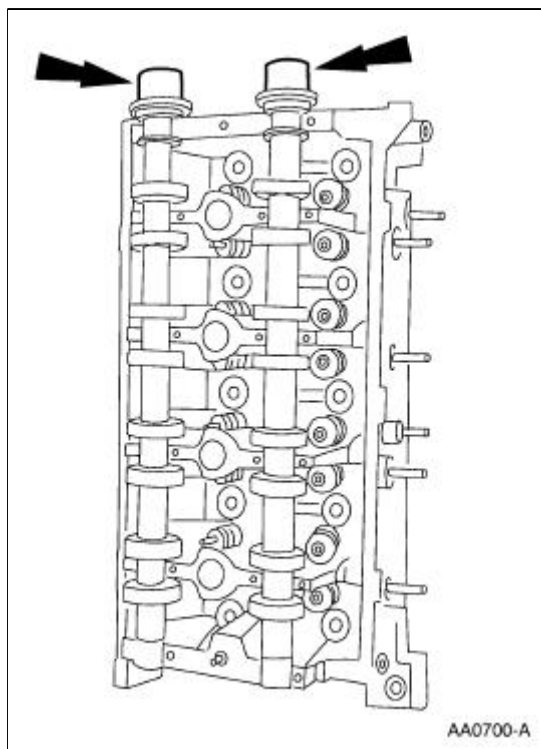


Installation

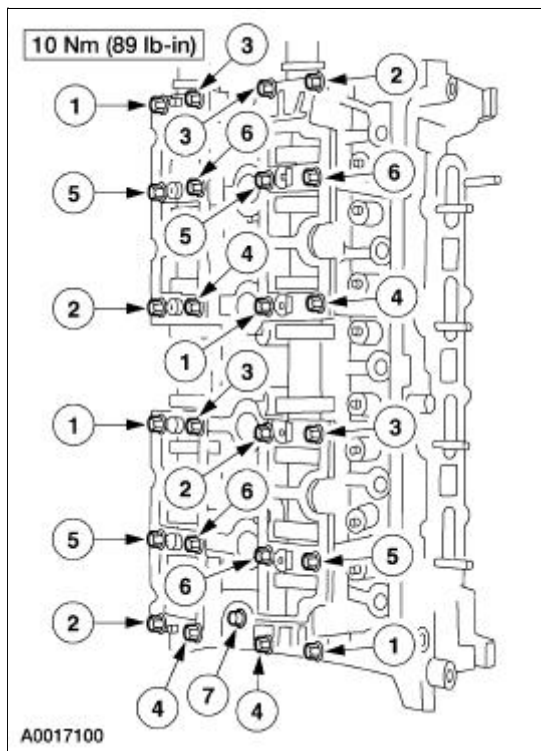
1. **NOTE:** LH shown; RH similar.

Install the camshafts.

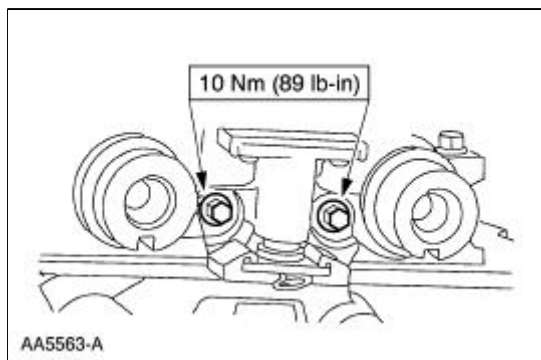
- Lubricate the camshafts with clean engine oil.



2. Install the camshaft bearing cap assemblies and tighten the bolts in the sequence shown.

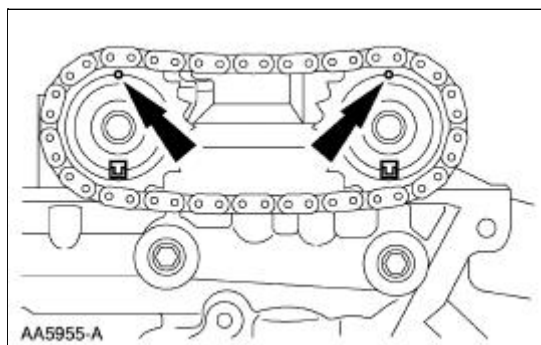


3. Install the bolts.

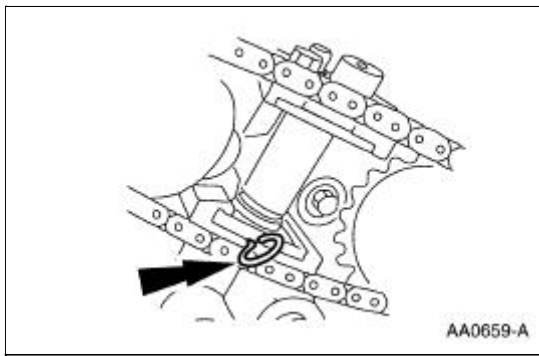


4.  **CAUTION:** Timing marks must be at 12 o'clock and indexed at 6 o'clock.

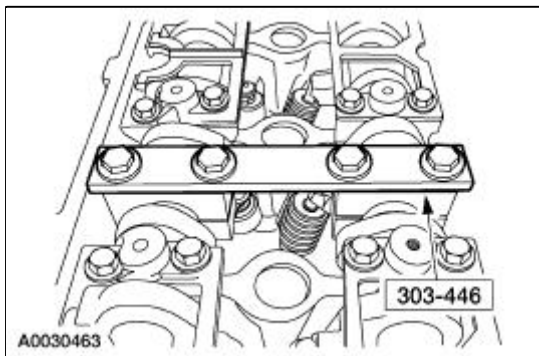
Install the camshaft sprockets and the chain as an assembly.



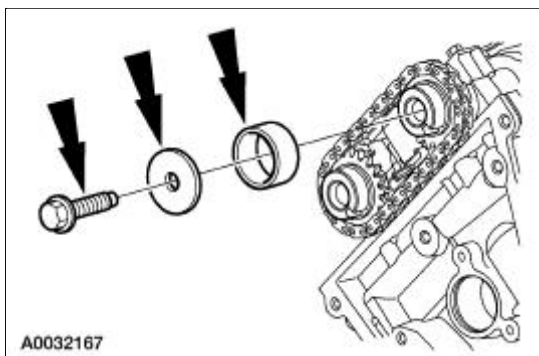
5. Remove the lockpin from the chain tensioner.



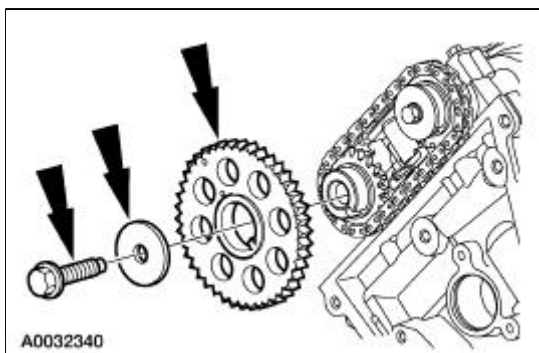
6. Install the special tool.



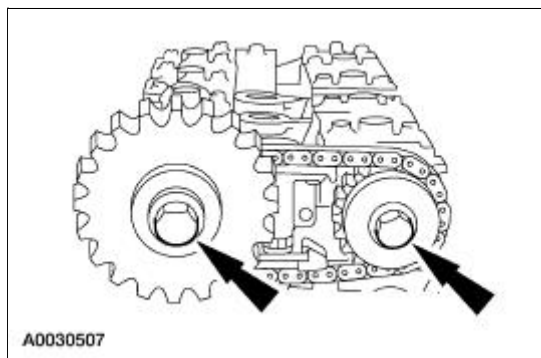
7. Install the camshaft spacer, washer and bolt and hand-tighten the bolt.



8. Install the camshaft sprocket, washer and bolt, and hand-tighten the bolt.



9. Tighten the bolts in two stages:
 - Stage 1: Tighten to 40 Nm (30 lb-ft).
 - Tighten an additional 90 degrees.

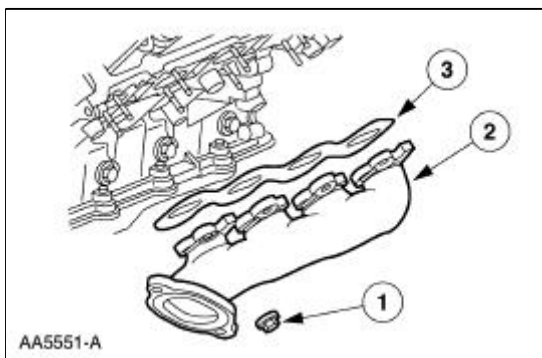


10. Remove the special tool.
 11. Install the left timing chain for the left side or both timing chains for the right side. For additional information, refer to [Timing Drive Components](#) in this section.
 12. Install the roller followers. For additional information, refer to [Camshaft Roller Follower](#) in this section.
-

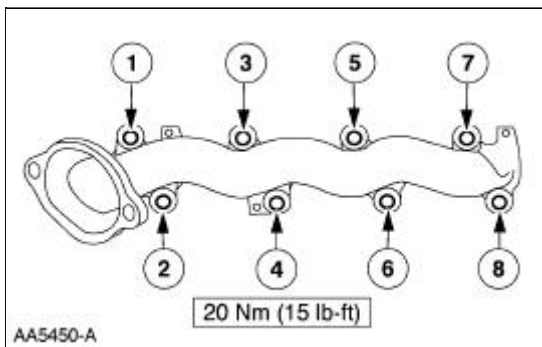
Exhaust Manifold RH

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
2. Raise the vehicle. For additional information, refer to [Section 100-02](#).
3. Remove the dual converter Y-pipe. For additional information, refer to [Section 309-00](#).
4. Remove the starter. For additional information, refer to [Section 303-06](#).
5. Remove the exhaust manifold.
 1. Remove the nuts.
 2. Remove the exhaust manifold.
 3. Remove and discard the gasket.



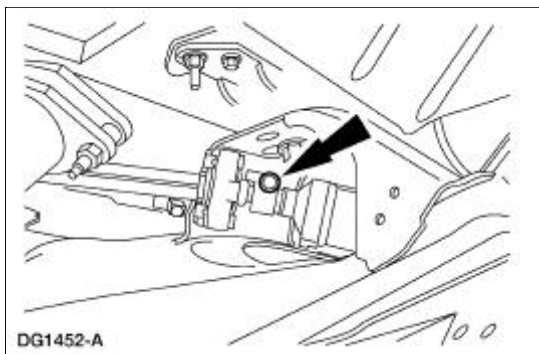
6. To install, reverse the removal procedure.
 - Use a new exhaust manifold gasket.
 - Tighten the exhaust manifold nuts in the sequence shown.



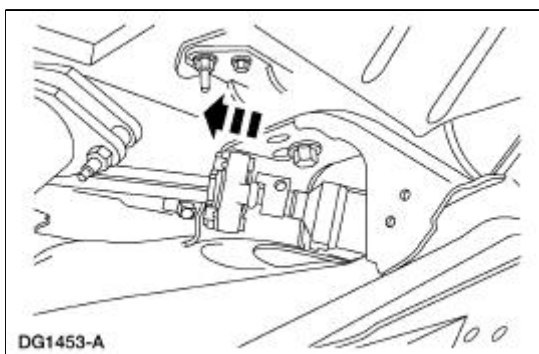
Exhaust Manifold LH

Removal and Installation

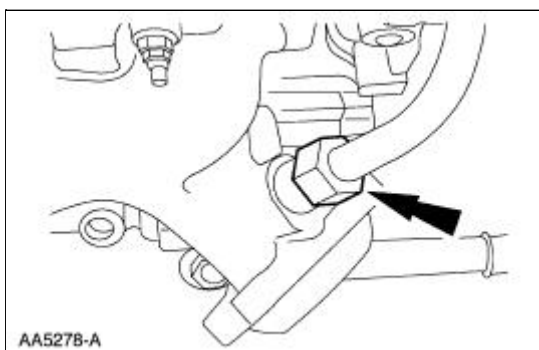
1. Position the steering wheel straight ahead and lock the column.
2. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the dual converter Y-pipe. For additional information, refer to [Section 309-00](#).
5. Remove and discard the pinch bolt.



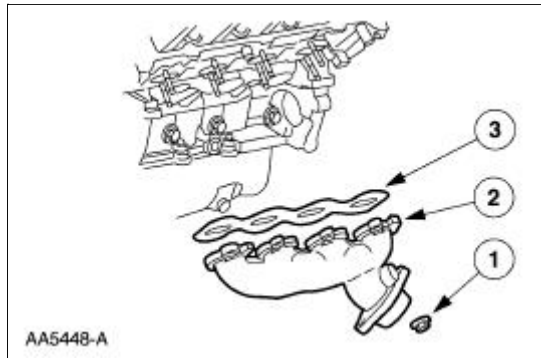
6. Separate the steering coupler.



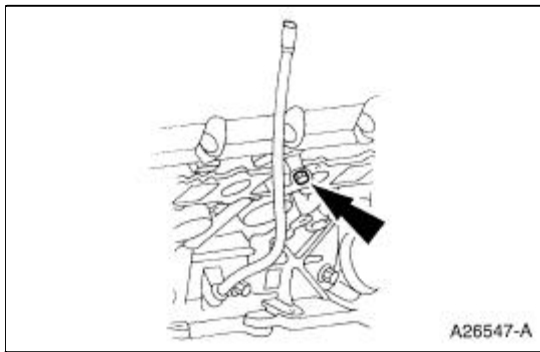
7. Disconnect the exhaust gas recirculation (EGR) tube at the exhaust manifold.



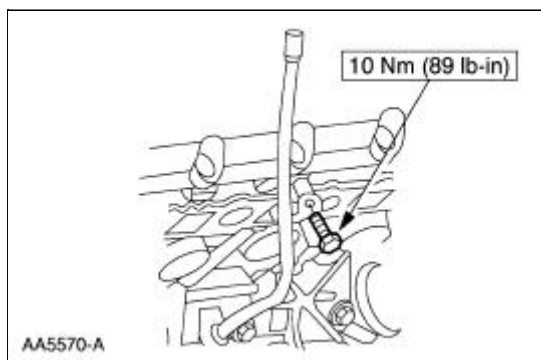
8. Remove the exhaust manifold.
 1. Remove the nuts.
 2. Remove the exhaust manifold.
 3. Remove and discard the gasket.

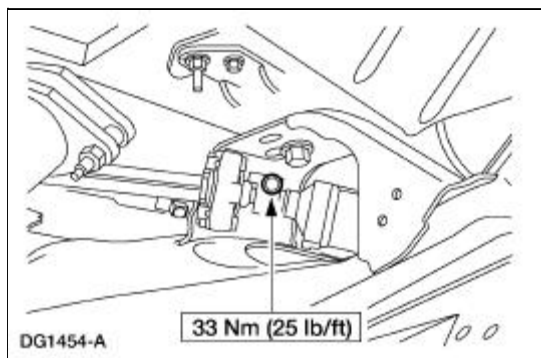
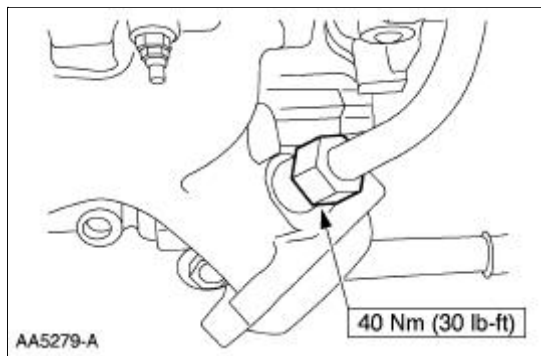
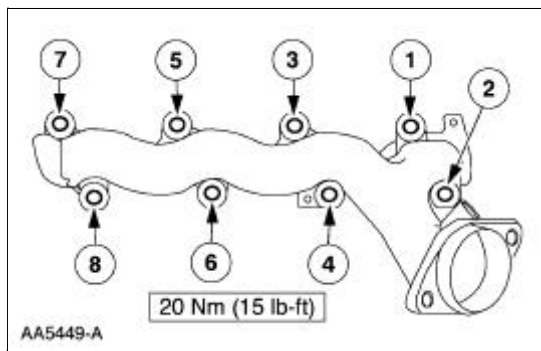


9. Remove the oil level indicator tube.



10. Remove and discard the exhaust manifold gasket.
11. To install, reverse the removal procedure.
 - Use a new exhaust manifold gasket.

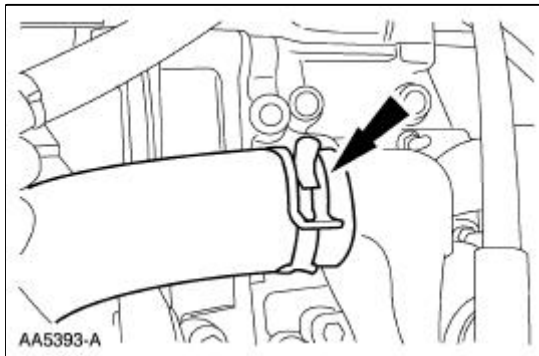




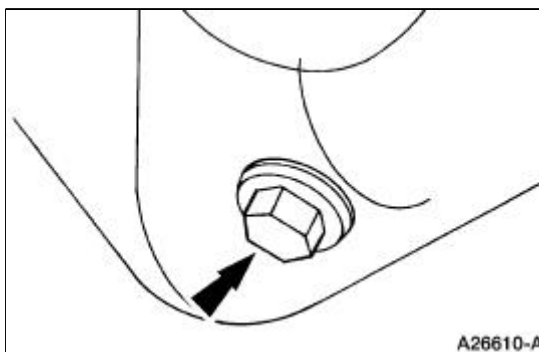
Oil Filter Adapter

Removal and Installation

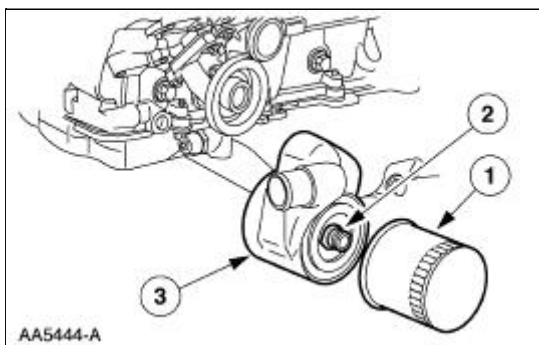
1. Drain the cooling system. For additional information, refer to [Section 303-03A](#)
2. Disconnect the lower radiator hose.



3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Drain the engine oil.



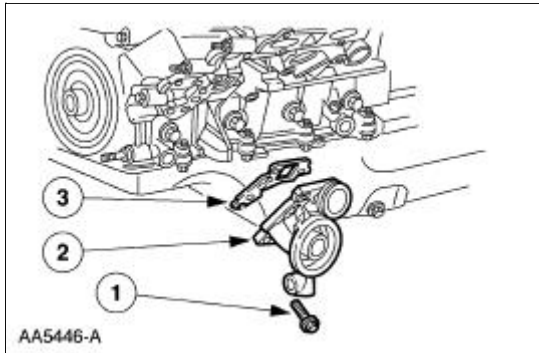
5. Remove the oil cooler.
 1. Remove the oil bypass filter.
 2. Remove the insert and the oil cooler.
 3. Inspect the O-ring and clean the sealing surface.



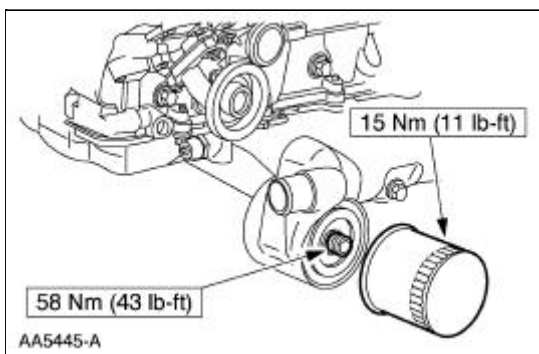
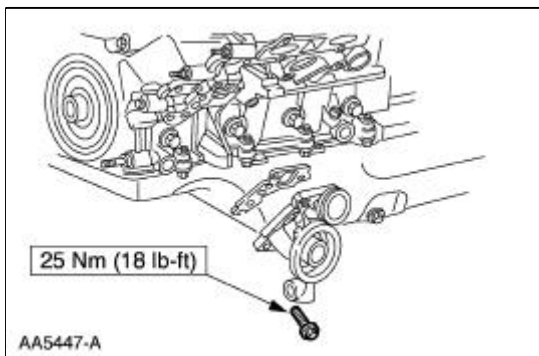
6. Clean and inspect the oil cooler.

- Plug the coolant connections.
- Flush the oil passages with parts cleaner. If metal particles are present in the oil cooler, install a new cooler.

7. Remove the oil filter adapter.
 1. Remove the bolts.
 2. Remove the oil filter adapter.
 3. Remove the gasket.



8. Clean and inspect the oil filter adapter.
 - Flush the oil filter adapter with parts cleaner. If metal particles are present in the adapter, install a new adapter.
9. To install, reverse the removal procedure.



Oil Level Indicator and Tube

Removal

1. Remove the oil level dipstick (6750).
2. Remove the LH exhaust manifold (9430). For additional information, refer to [Exhaust Manifold LH](#) in this section.
3. Remove the bolt.

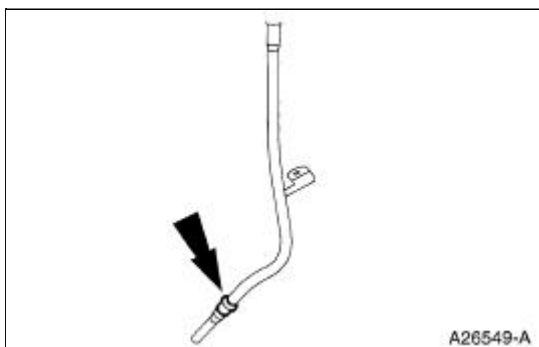


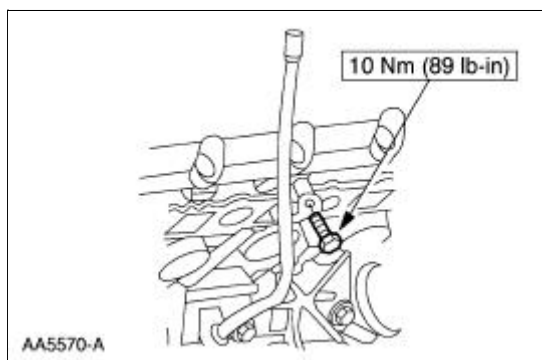
4. Remove the oil level indicator tube (6754).



Installation

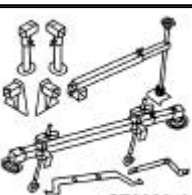
1. To install, follow the removal procedure in reverse.





Oil Pan

Special Tool(s)

 ST1352-A	Compressor, Coil Spring 204-D001 (D78P-5310-A)
 ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST2333-A	3-Bar Engine Support Kit 303-F072

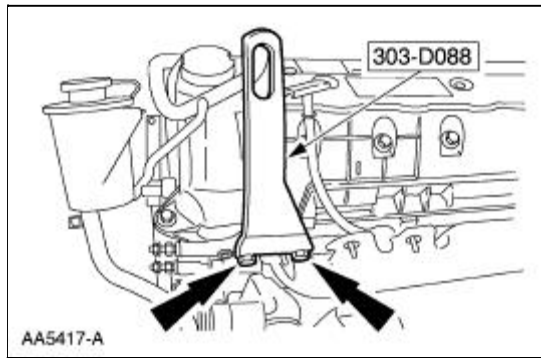
Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

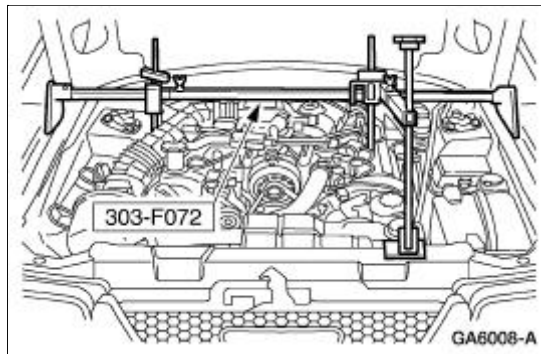
Removal

1. Disconnect the battery ground cable (14301). For additional information, refer to [Section 414-01](#).
2. Remove the transmission. For additional information, refer to [Section 308-03B](#).
3. Remove the air cleaner outlet tube (9B659). For additional information, refer to [Section 303-12](#).
4. Remove the radiator sight shield (8C251).
5. Remove the manifold and tube assembly—accumulator to compressor, 4.6L. For additional information, refer to [Section 412-03](#).
6. Remove the A/C line. For additional information, refer to [Section 412-03](#).

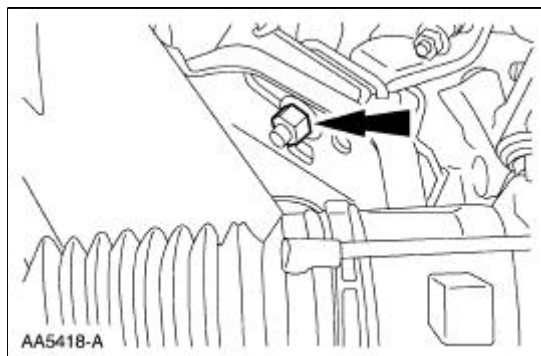
7. Install the special tools.



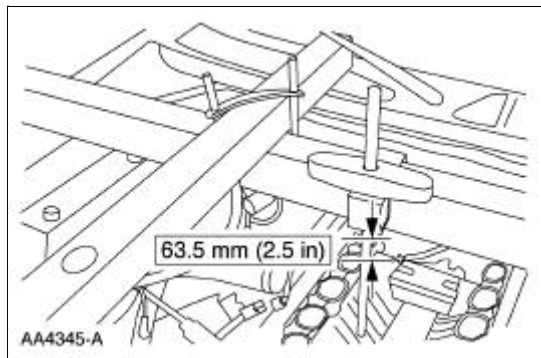
8. Install the special tool.



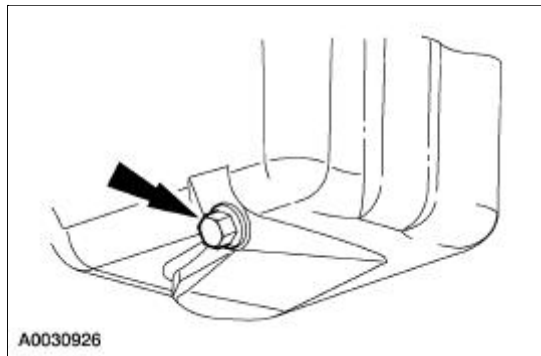
9. Raise the vehicle on a hoist. For additional information, refer to [Section 100-02](#).
10. Remove the two nuts.



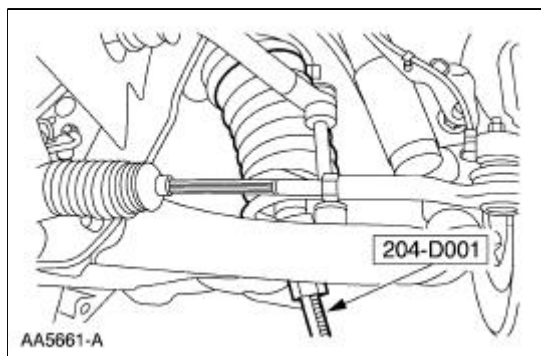
11. Lower the vehicle.
12. Using the special tool, raise the engine.



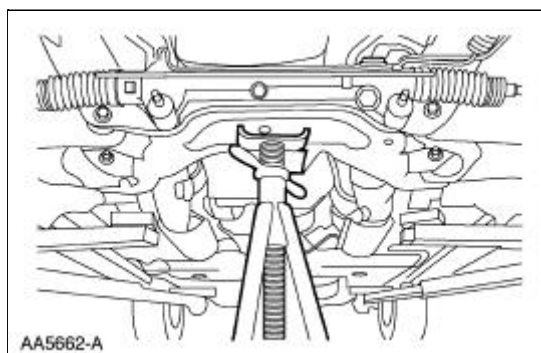
13. Raise the vehicle on a hoist.
14. Remove the oil pan drain plug (6730) and drain the engine oil.



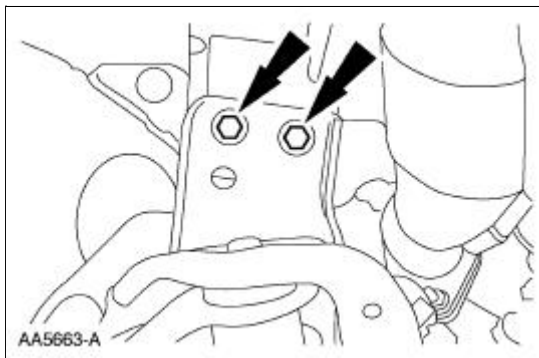
15. Using the special tool, compress the front coil springs (5310).



16. Position a safety stand.

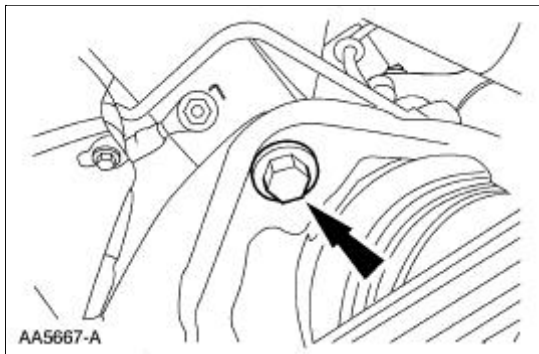


17. Remove the four bolts.

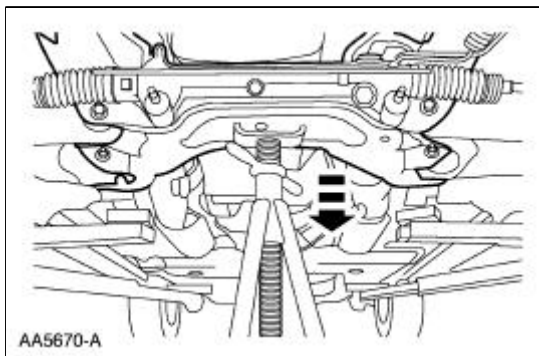


18. **NOTE:** Do not completely remove the bolts.

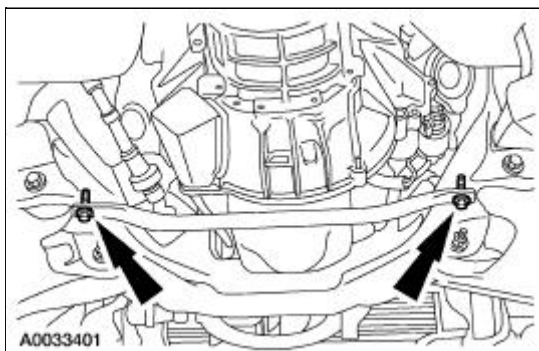
Loosen the bolts.



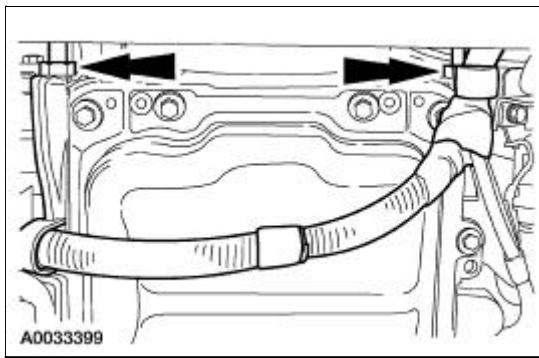
19. Lower the front sub-frame (5C145).



20. Remove the sub-frame brace.



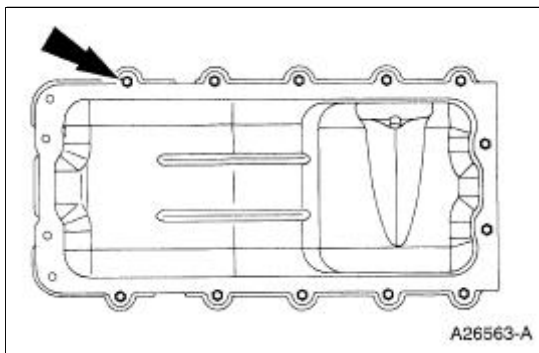
21. Remove the starter wiring harness nuts and position the wiring harness out of the way.



22. **NOTE:** Be careful when removing the oil pan gasket. It is reusable.

Remove the oil pan and gasket.

- Inspect the oil pan gasket for damage.



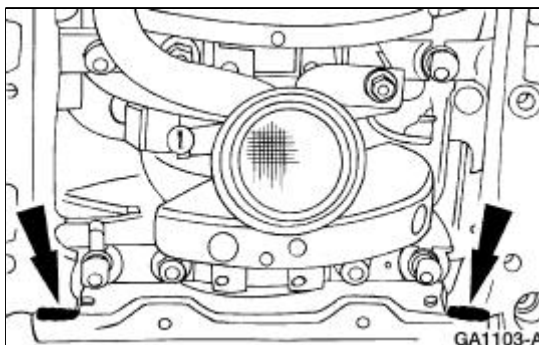
Installation

1. **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Clean and inspect the mating surfaces.

2. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure may result in future oil leakage.

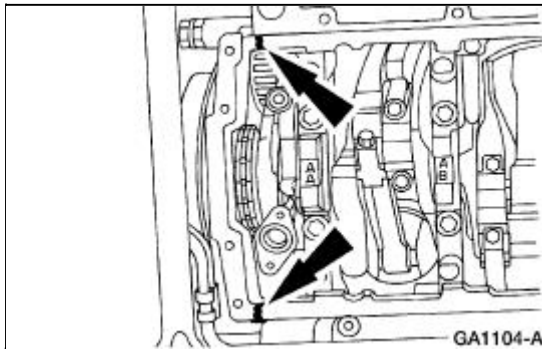
Apply silicone gasket and sealant at the engine front cover-to-cylinder block mating surface.



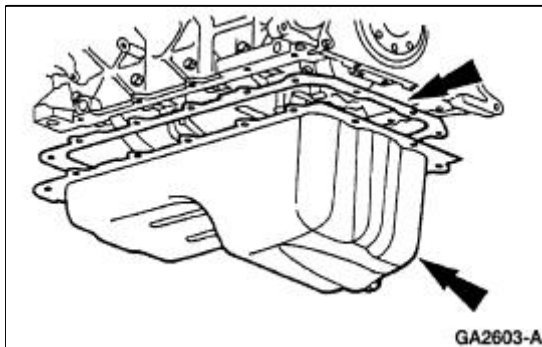
3. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness,

or four minutes, whichever is longer. Failure to follow this procedure may result in future oil leakage.

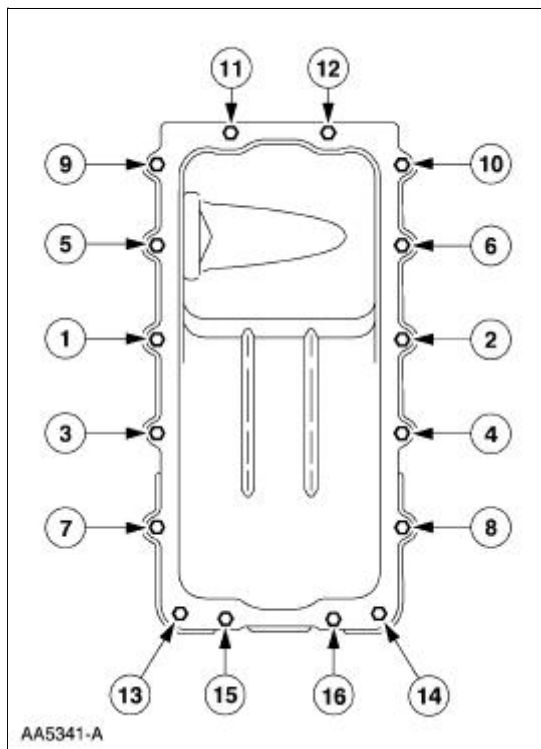
Apply silicone gasket and sealant at the rear oil seal retainer-to-cylinder block sealing surface.



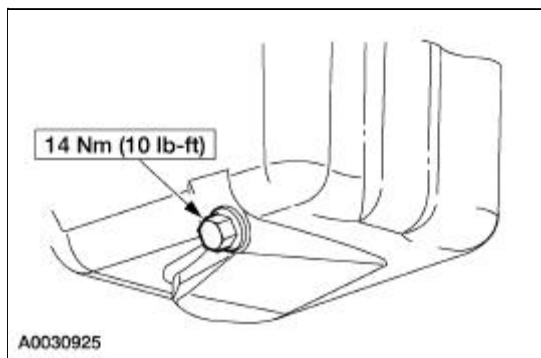
4. Install the oil pan and gasket and loosely install the bolts.



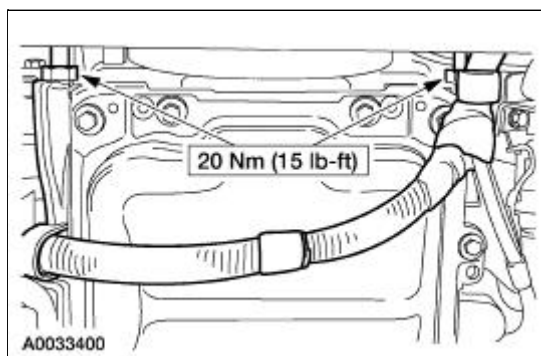
5. Tighten the bolts in the sequence shown in three stages.
 - Stage 1: Tighten to 2 Nm (18 lb-in).
 - Stage 2: Tighten to 20 Nm (15 lb-ft).
 - Stage 3: Tighten an additional 60 degrees.



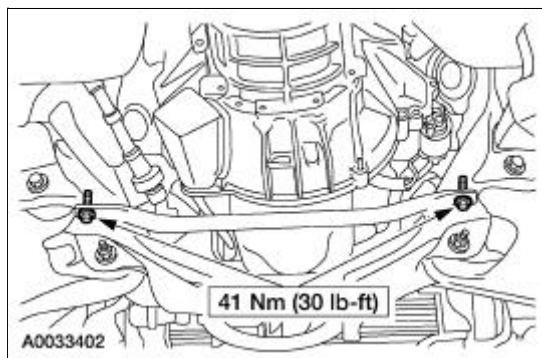
6. Install the oil pan drain plug.



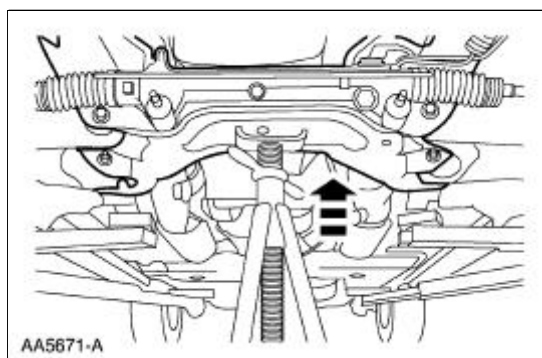
7. Position the starter wiring harness and install the wiring harness nuts.



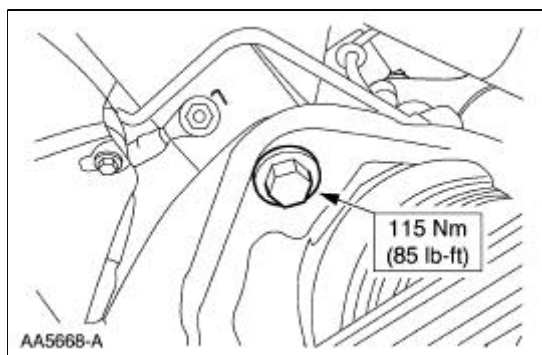
8. Install the sub-frame brace.



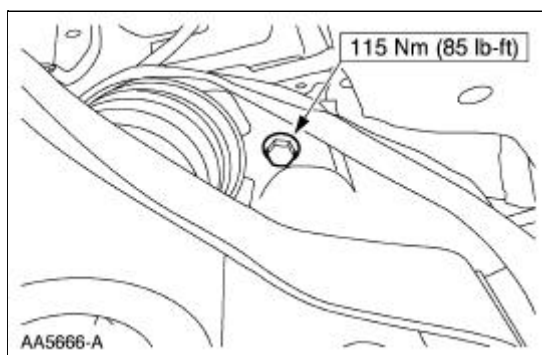
9. Raise the front sub-frame into position.



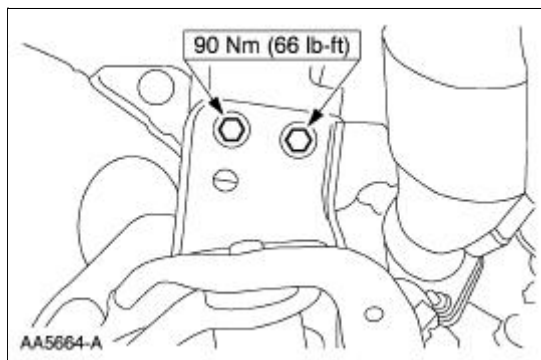
10. Install the two bolts.



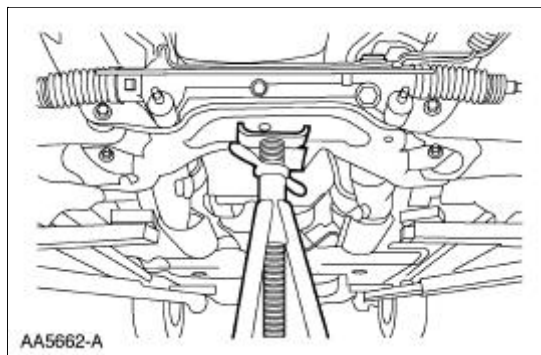
11. Install the two bolts.



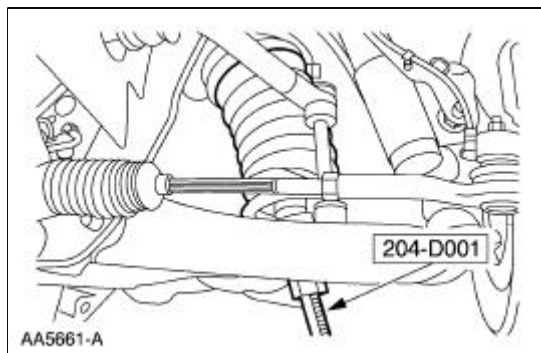
12. Install the four bolts.



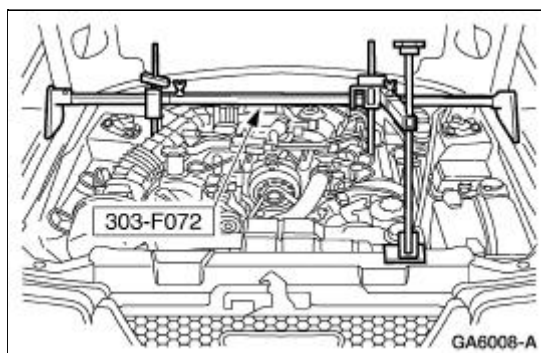
13. Position the safety stand aside.



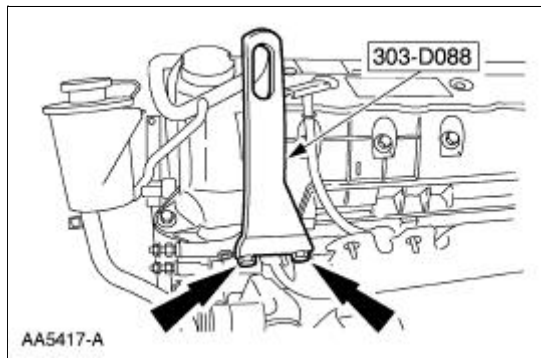
14. Release the tension from the front coil springs and remove the special tool.



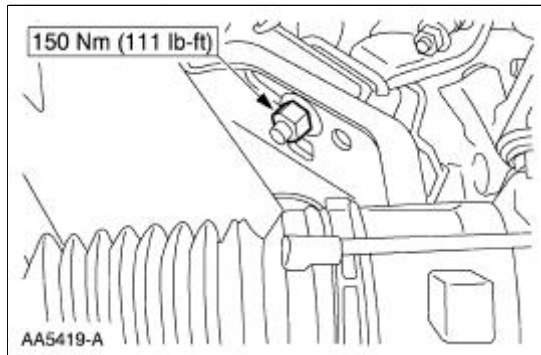
15. Raise the vehicle.
16. Using the special tool, lower the engine and remove the special tool.



17. Remove the special tools.



18. Install the two nuts.

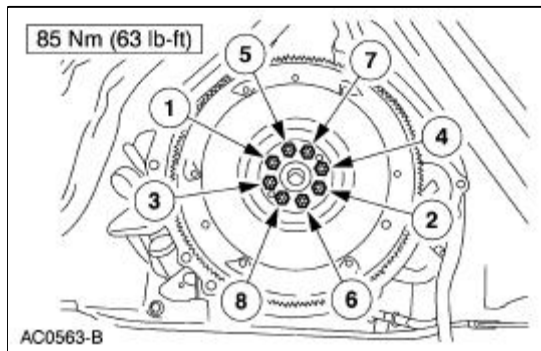


19. Install the transmission. For additional information, refer to [Section 308-03B](#).
 20. Lower the vehicle.
 21. Fill the engine crankcase with clean engine oil.
 22. Install the A/C line. For additional information, refer to [Section 412-03](#).
 23. Install the manifold and tube assembly—accumulator to compressor, 4.6L. For additional information, refer to [Section 412-03](#).
 24. Install the radiator sight shield.
 25. Install the air cleaner outlet tube. For additional information, refer to [Section 303-12](#).
 26. Install the battery ground cable. For additional information, refer to [Section 414-01](#).
 27. Start the engine and check for leaks.
-

Flywheel

Removal

1. Remove the clutch components. For additional information, refer to [Section 308-01](#).
2. Remove the bolts and the flywheel.

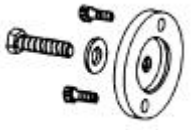
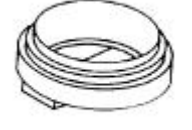
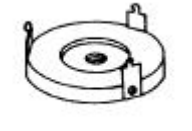


Installation

1. To install, reverse the removal procedure.

Crankshaft Rear Seal with Retainer Plate

Special Tool(s)

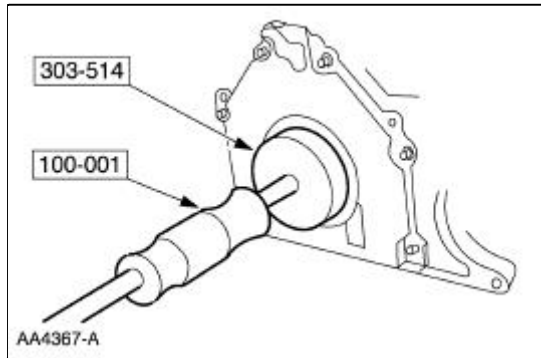
 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1479-A	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
 ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 ST1482-A	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

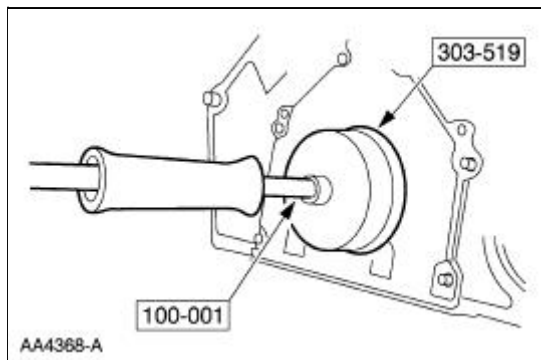
Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the flywheel. For additional information, refer to [Flywheel](#) in this section.
2. Using the special tools, remove the crankshaft oil slinger.

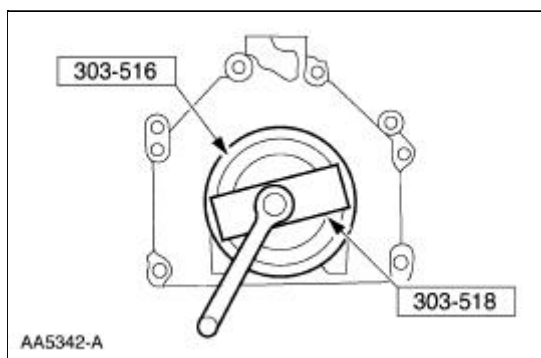


3. Using the special tools, remove the crankshaft rear oil seal (6701).

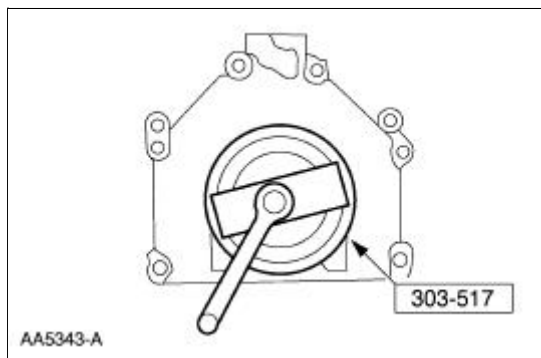


Installation

1. Using the special tools, install the crankshaft rear oil seal.
 - Lubricate the oil seal using clean engine oil.



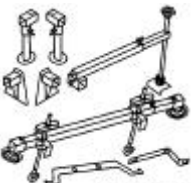
2. Using the special tool, install the crankshaft oil slinger.



3. Install the flywheel. For additional information, refer to [Flywheel](#) in this section.
-

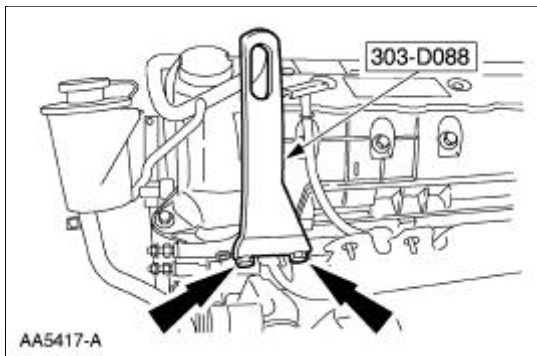
Engine Mount RH

Special Tool(s)

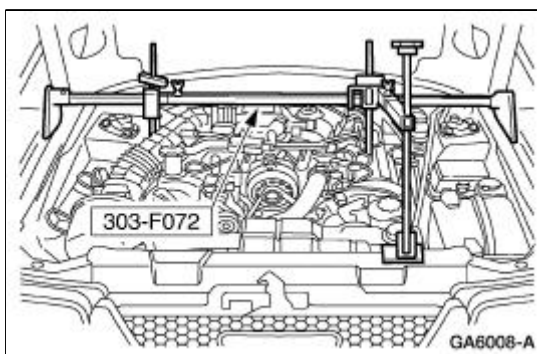
 ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST2333-A	3-Bar Engine Support Kit 303-F072

Removal

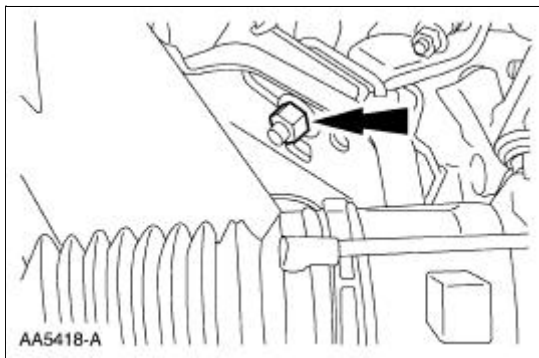
1. Install the special tools.



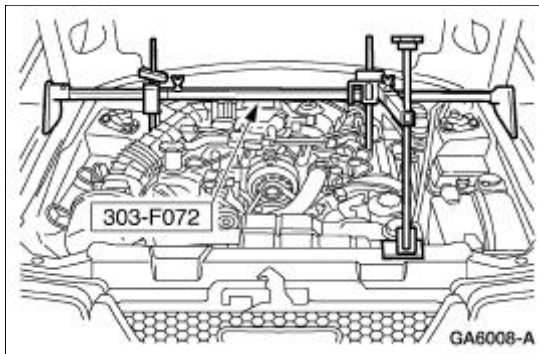
2. Install the special tool.



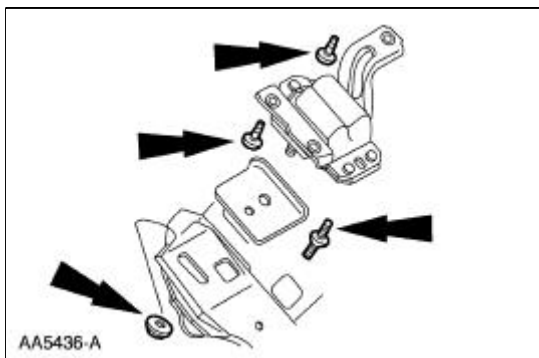
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the two nuts.



5. Lower the vehicle.
6. Using the special tool, raise the engine.

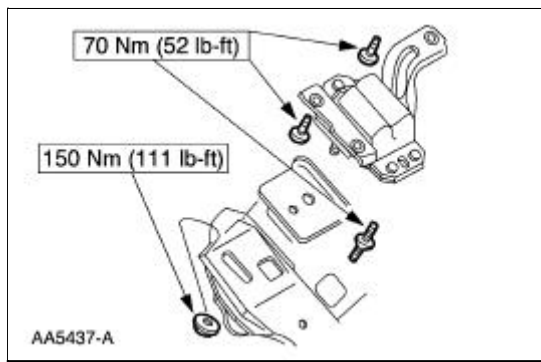


7. Raise the vehicle.
8. Remove the engine mount.



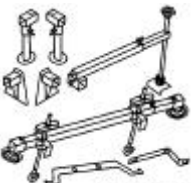
Installation

1. To install, reverse the removal procedure.



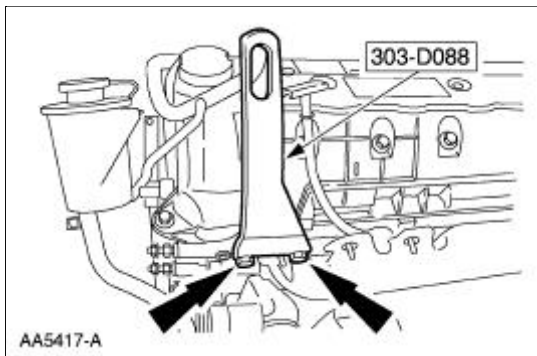
Engine Mount LH

Special Tool(s)

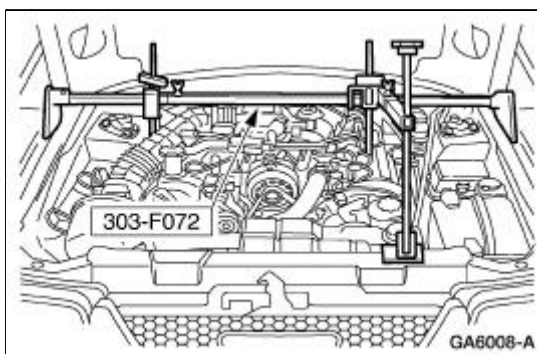
 ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST2333-A	3-Bar Engine Support Kit 303-F072

Removal

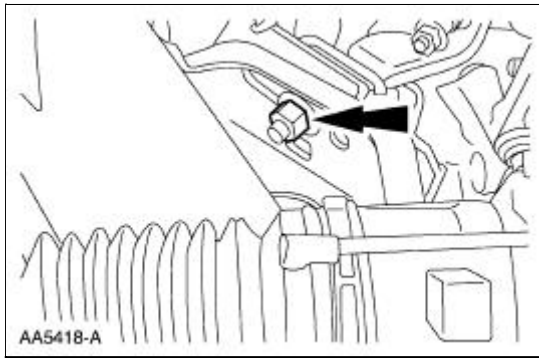
1. Install the special tools.



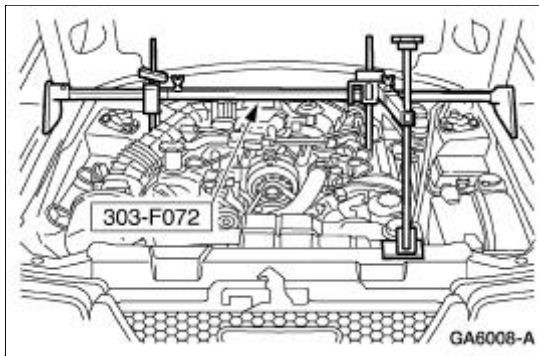
2. Install the special tool.



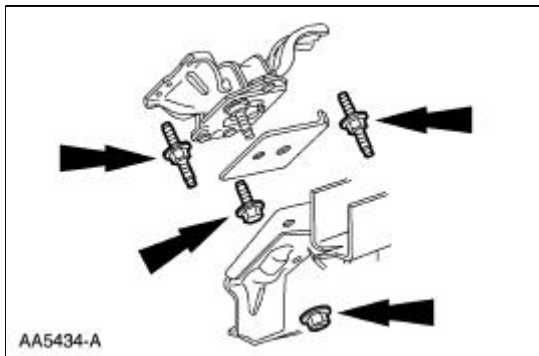
3. Raise the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the two nuts.



5. Lower the vehicle.
6. Using the special tool, raise the engine.

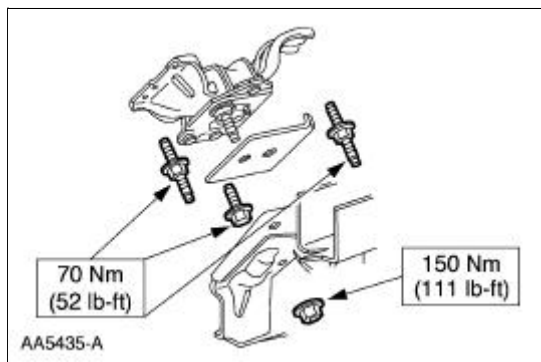


7. Raise the vehicle on a hoist.
8. Remove the engine mount.



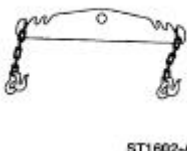
Installation

1. To install, follow the removal procedure in reverse.



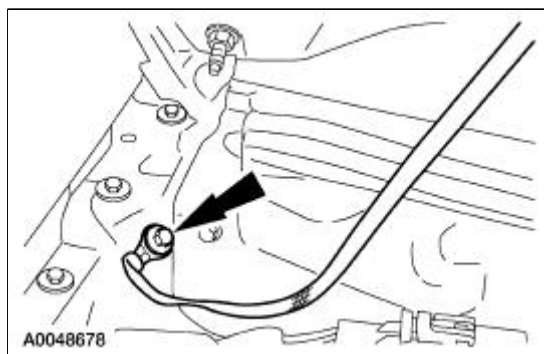
Engine

Special Tool(s)

 ST1603-A	Lifting Bracket, Engine 303-D087 (D93P-6001-A1)
 ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)

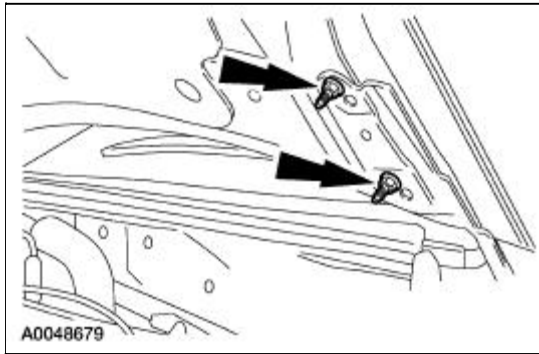
Removal

1. Remove the battery. For additional information, refer to [Section 414-01](#).
2. Release the fuel pressure. For additional information, refer to [Section 310-00](#).
3. Drain the engine cooling system. For additional information, refer to [Section 303-03A](#).
4. Drain the supercharger cooling system. For additional information, refer to [Section 303-03B](#).
5. Recover the A/C system refrigerant. For additional information, refer to [Section 412-00](#).
6. Remove the hood-to-body ground strap.

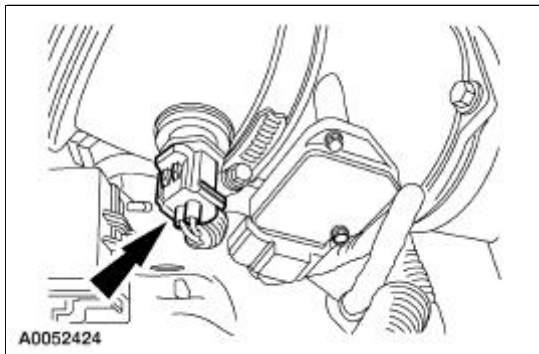


7. **NOTE:** Mark the hood hinge locations to aid in hood installation.

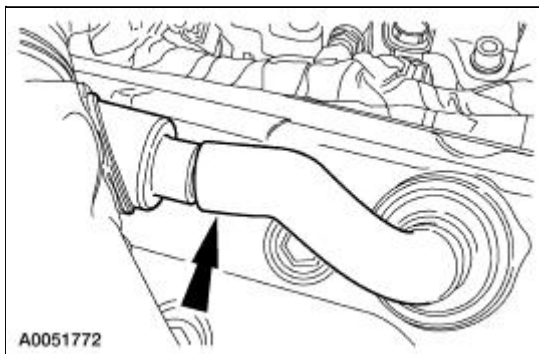
Remove the four nuts and the hood.



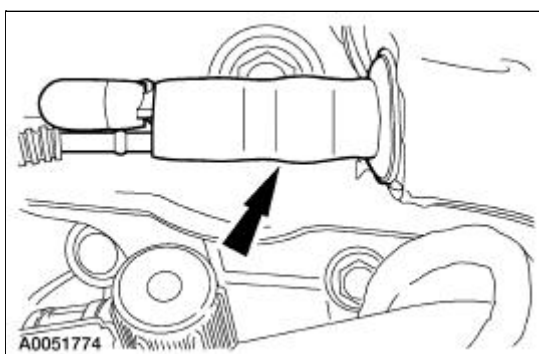
8. Disconnect the intake air temperature (IAT) sensor.



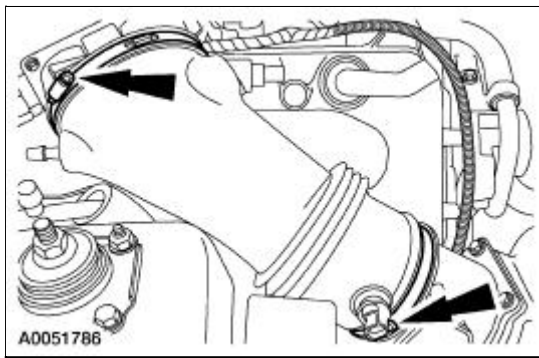
9. Disconnect the breather hose.



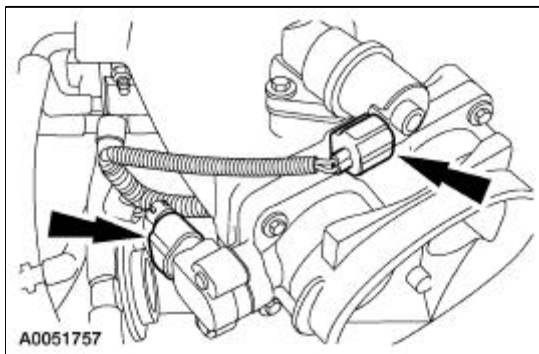
10. Disconnect the vacuum hose.



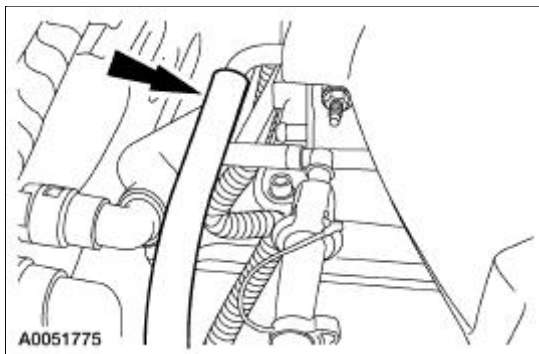
11. Loosen the clamps and remove the air cleaner outlet pipe.



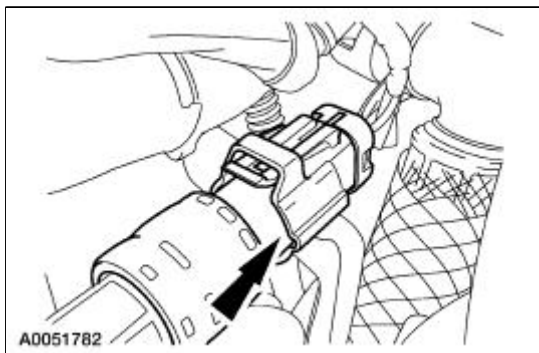
12. Disconnect the throttle position (TP) sensor and the idle air control (IAC) valve electrical connectors.



13. Disconnect the vacuum hose.



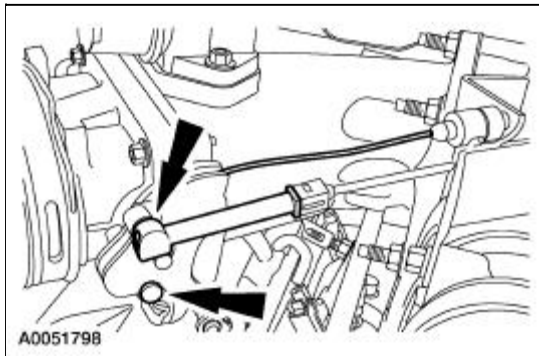
14. Disconnect the A/C pressure switch electrical connector.



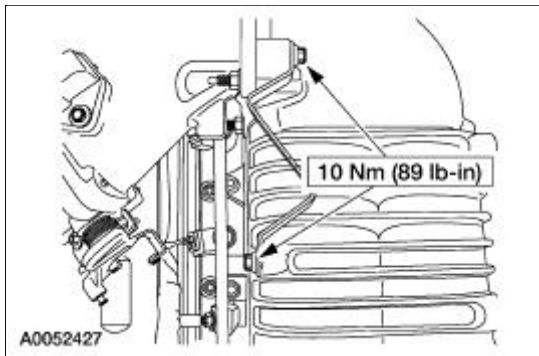
15. Disconnect the fuel tube spring lock coupling. For additional information, refer to [Section 310-00](#).

16. Disconnect the accelerator controls.

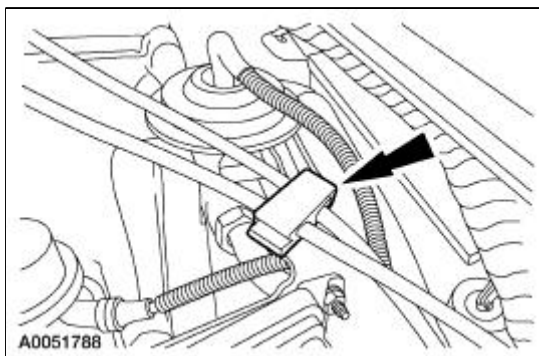
- Disconnect the accelerator cable.
- If equipped, disconnect the speed control cable.



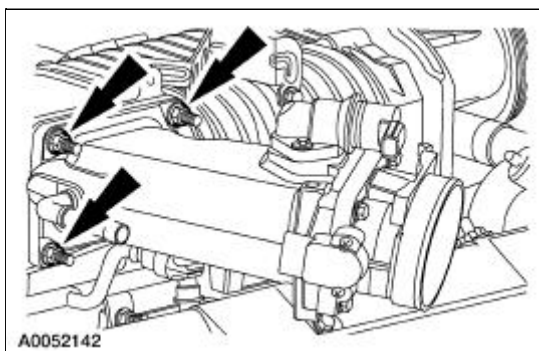
17. Remove the accelerator cable bracket bolts.



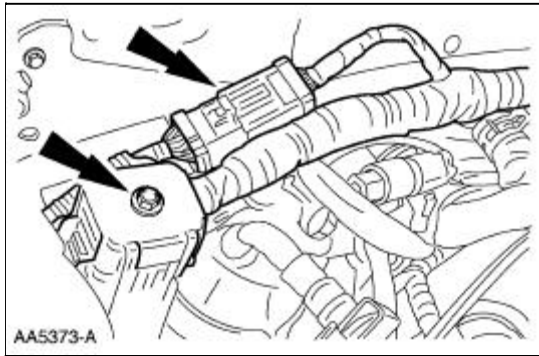
18. Release the clip and position the accelerator cable bracket and the cables aside.



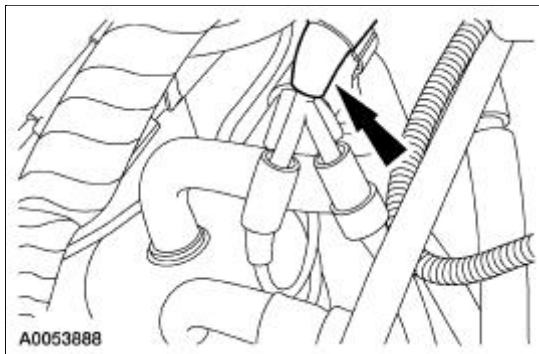
19. Remove the four nuts and the throttle body and spacer assembly.



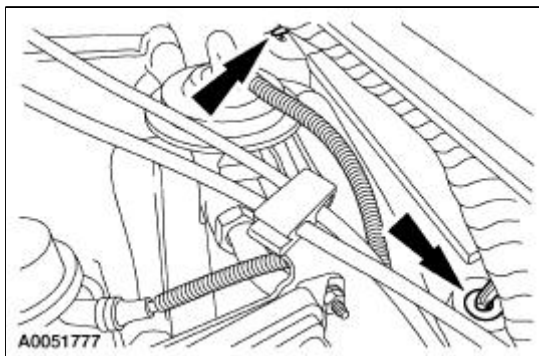
20. Disconnect the 16-pin and the 42-pin connectors.



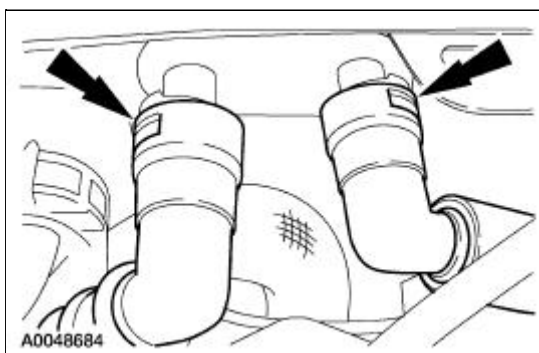
21. Disconnect the vacuum hoses.



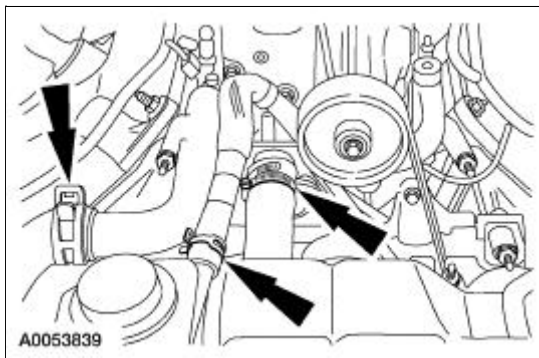
22. Separate the wiring harness from the dash panel.



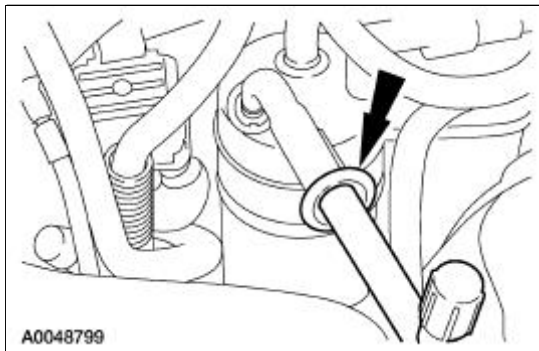
23. Disconnect the heater hoses.



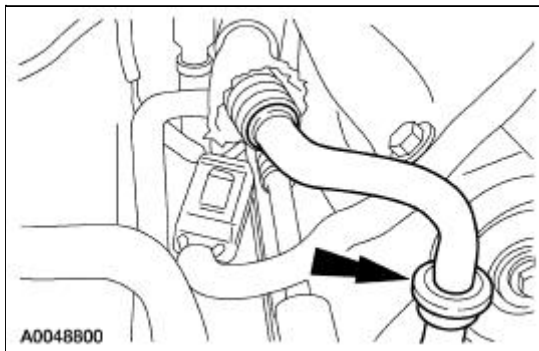
24. Disconnect the radiator upper hose, radiator lower hose and the supercharger degas hose.



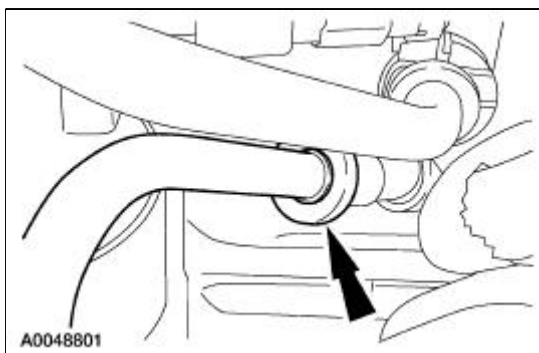
25. Disconnect the A/C suction tube from the accumulator.



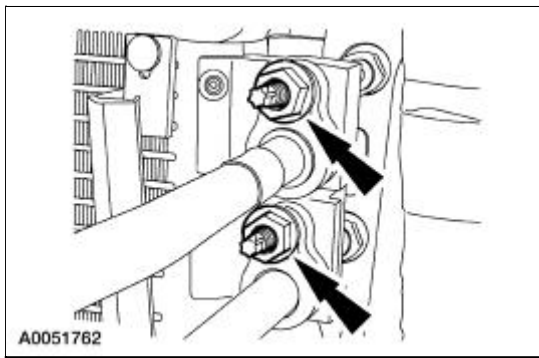
26. Disconnect and remove the A/C suction tube.



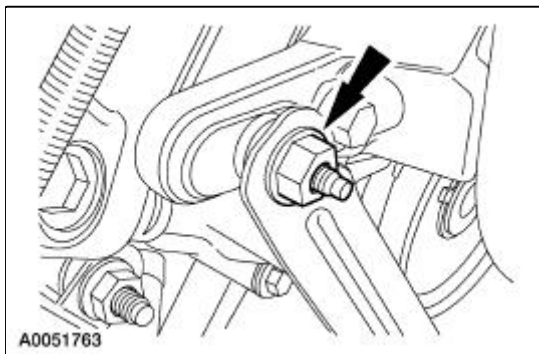
27. Disconnect the A/C tube.



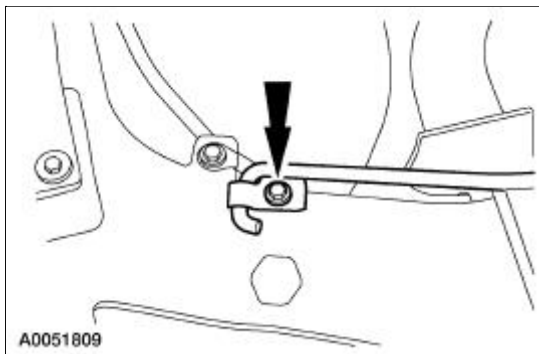
28. Remove the nuts and disconnect the A/C tubes.



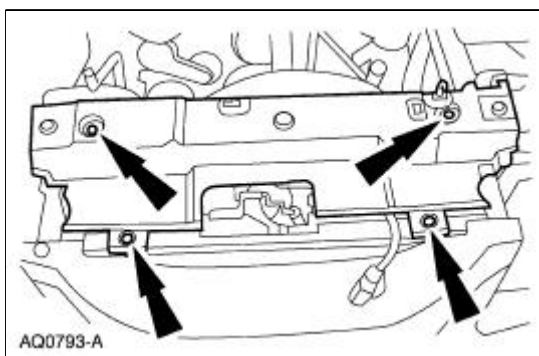
29. Remove the nut and the A/C manifold tube.



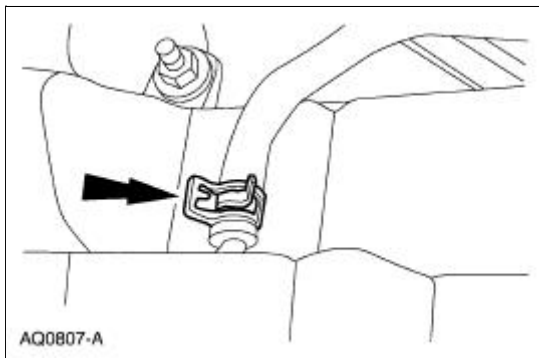
30. Remove the hood prop.



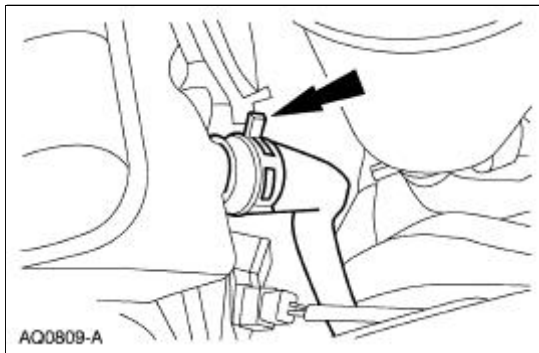
31. Remove the push pins and the radiator sight shield.



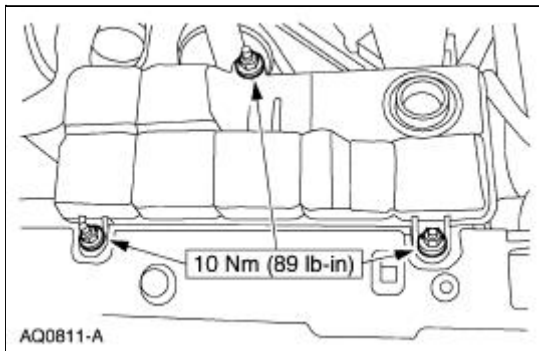
32. Disconnect the radiator vent hose from the degas bottle.



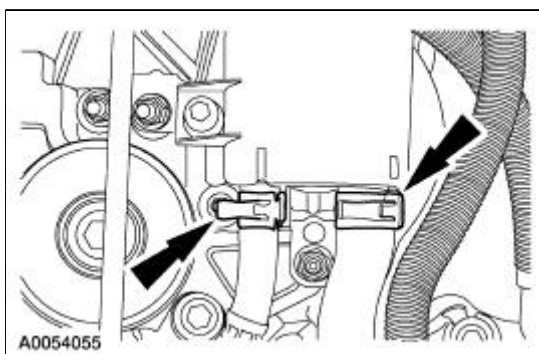
33. Remove the degas bottle return hose.



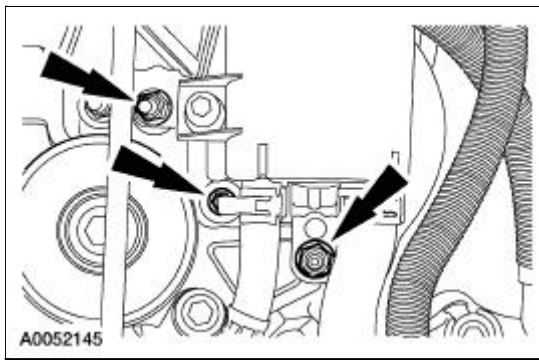
34. Remove the nuts and the degas bottle.



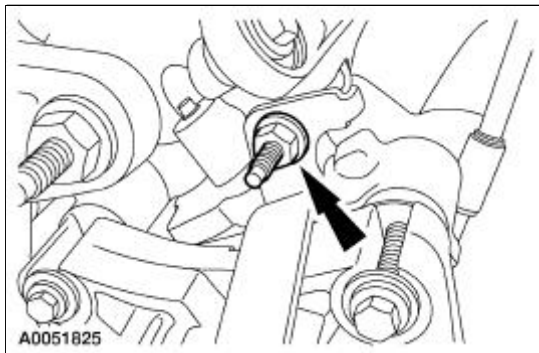
35. Disconnect the power steering hoses.



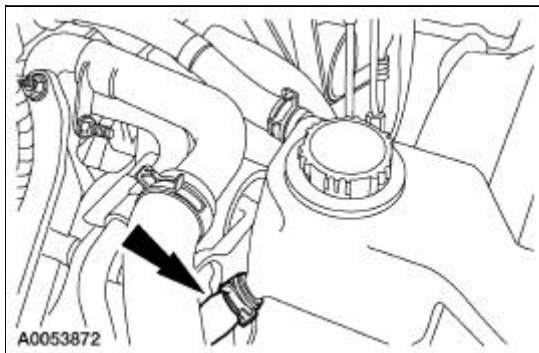
36. Remove the fasteners, and the power steering reservoir and bracket.



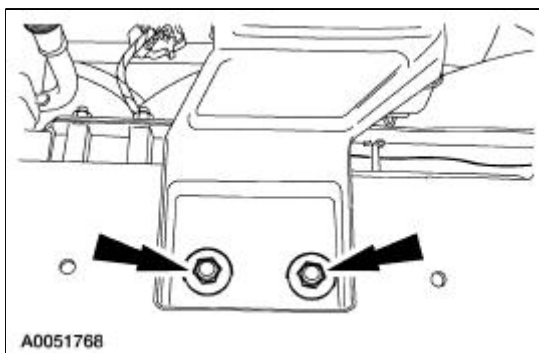
37. Remove the power steering hose bracket.



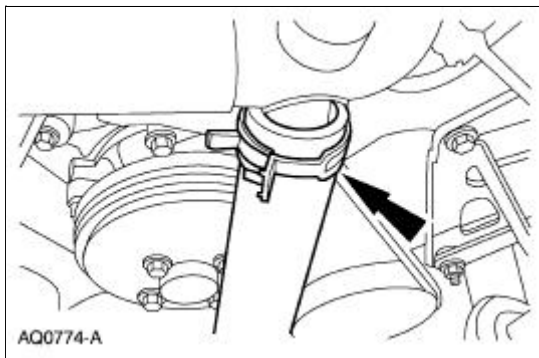
38. Disconnect the supercharger degas hose.



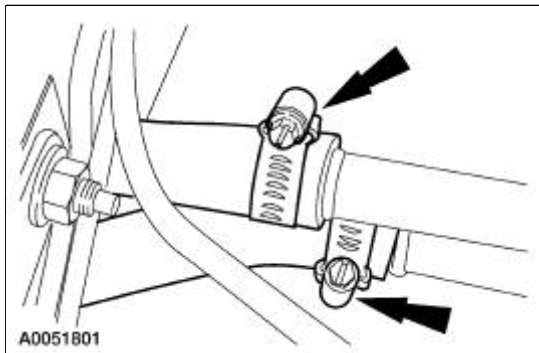
39. Remove the bolts and the supercharger degas bottle.



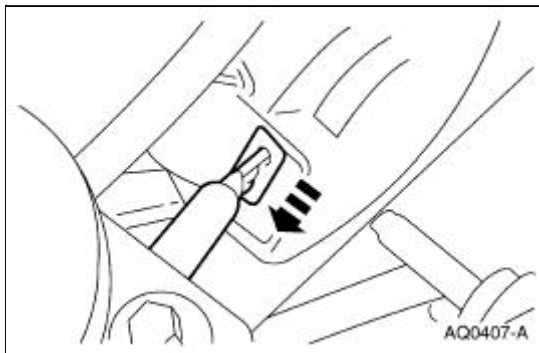
40. Disconnect the radiator lower hose.



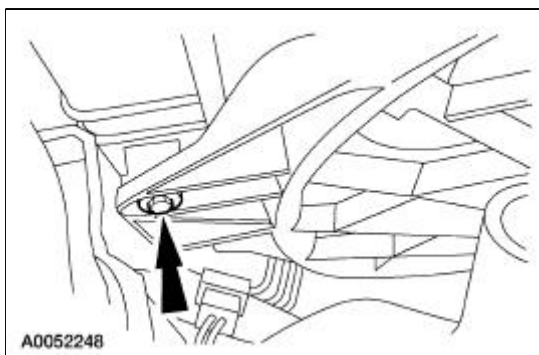
41. Disconnect the supercharger coolant hoses.



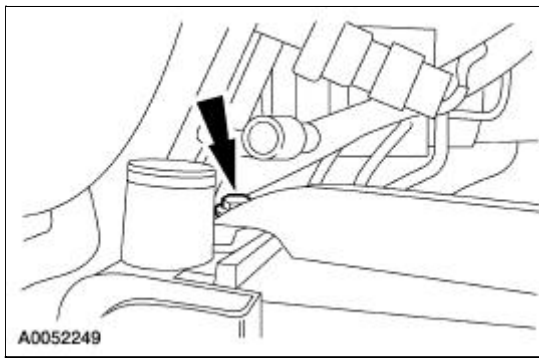
42. Disconnect the cooling fan electrical connector.



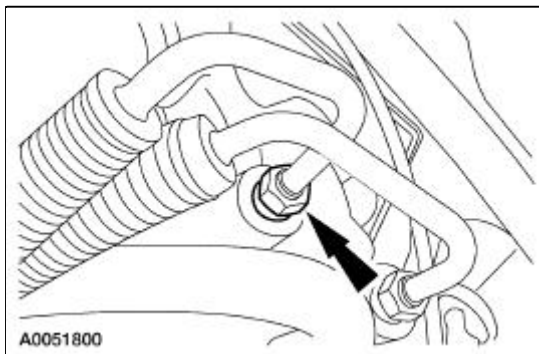
43. Remove the LH cooling fan shroud bolt.



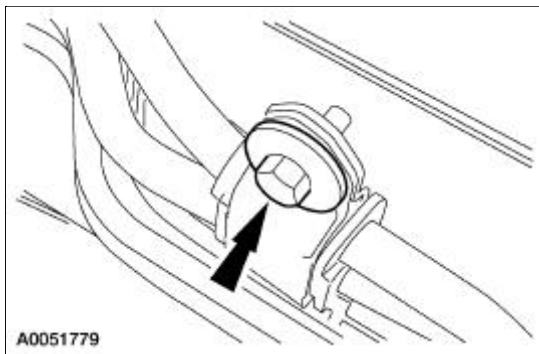
44. Remove the RH cooling fan shroud bolt, and remove the fan, motor and shroud as an assembly.



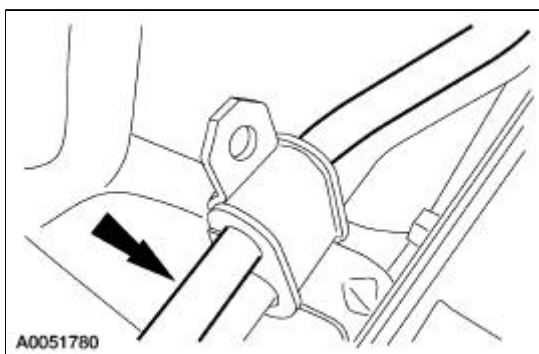
45. Disconnect the power steering hose.



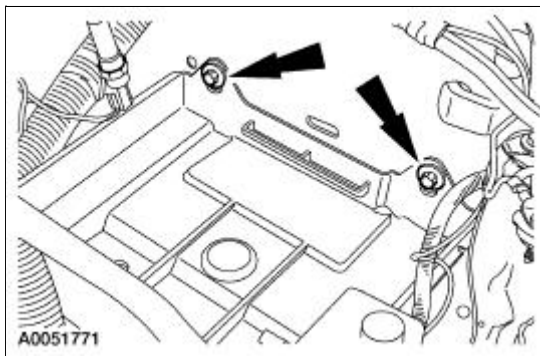
46. Remove the power steering bracket bolt.



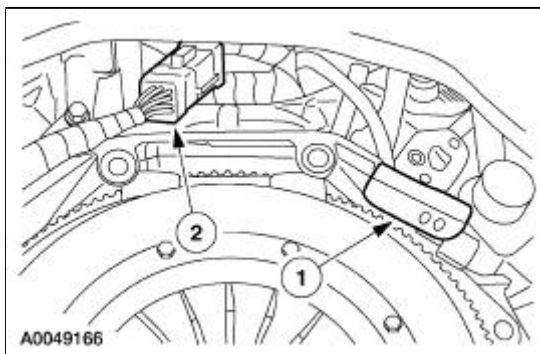
47. Remove the power steering hose from the grommet.



48. Remove the bolts and the battery tray.

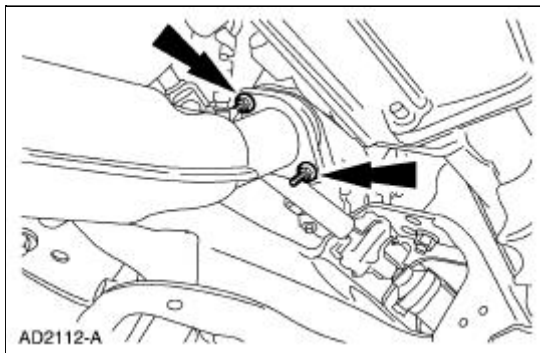


49. Remove the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
50. Remove the clutch. For additional information, refer to [Section 308-01](#).
51. Remove the transmission wiring harness.
 1. Remove the RH oxygen sensor connector from the bracket.
 2. Disconnect the transmission wiring connector and remove the harness.

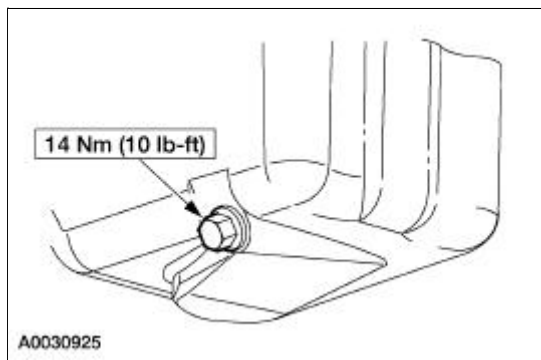


52. **NOTE:** LH is shown, RH is similar.

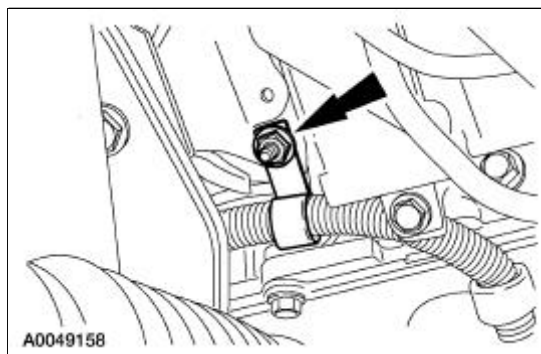
Remove the right and left exhaust manifold flange nuts, and position the exhaust manifold aside.



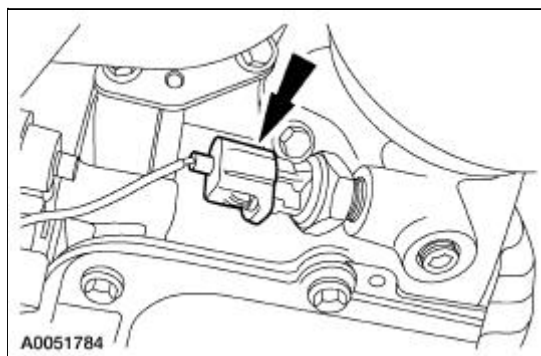
53. Drain the engine oil.
 - Install the drain plug when finished.



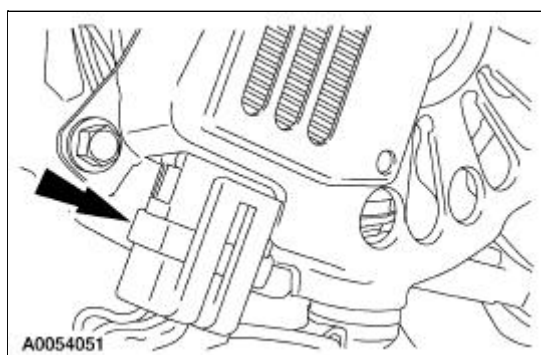
54. Remove the nut and the wiring harness bracket.



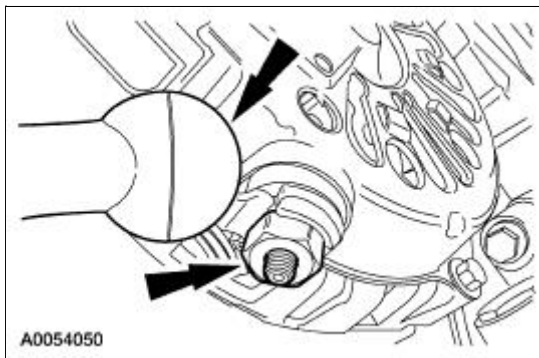
55. Disconnect the oil pressure sender electrical connector.



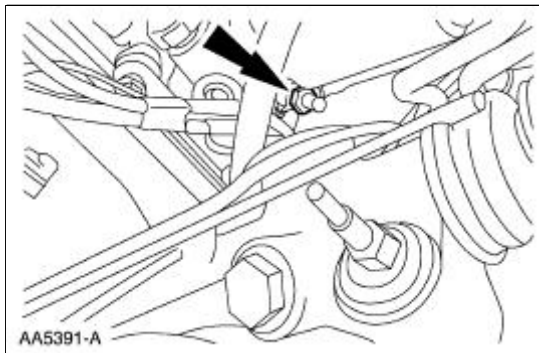
56. Disconnect the generator electrical connector.



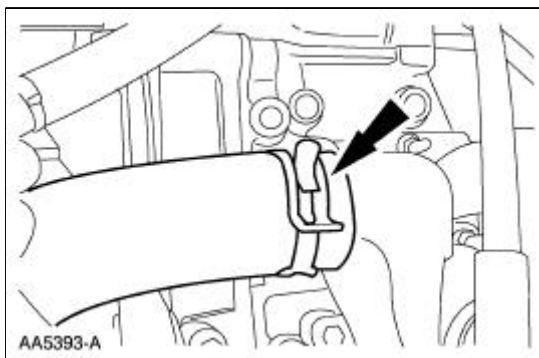
57. Remove the generator B + nut and disconnect the B + cable.



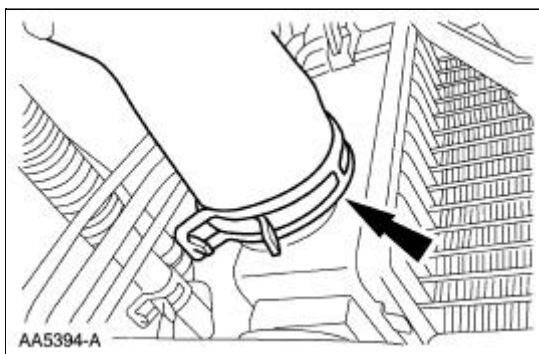
58. Remove the nut and the engine ground cable.



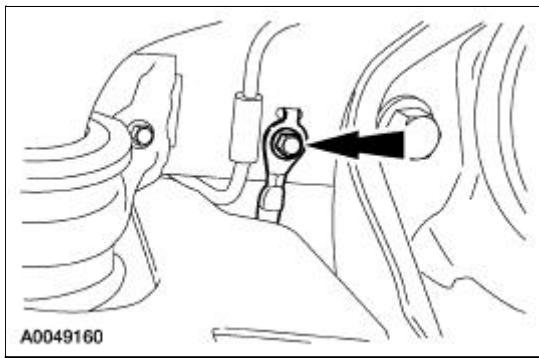
59. Disconnect the hose from the oil filter adapter.



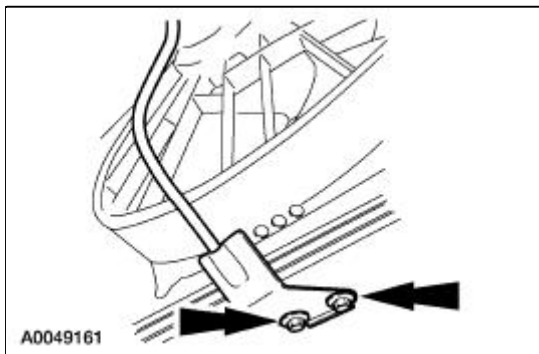
60. Disconnect and remove the lower hose from the radiator.



61. Remove the ground strap bolt.

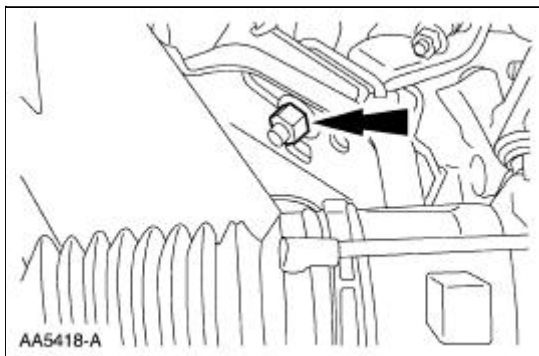


62. Remove the degas bottle support bracket.



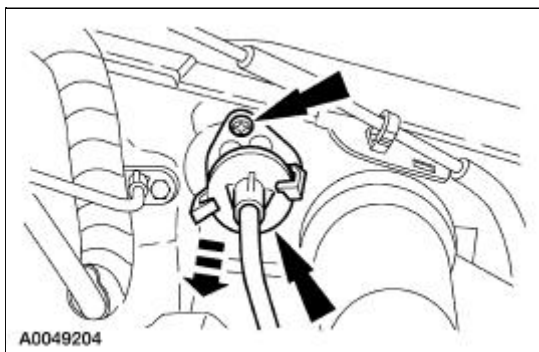
63. **NOTE:** RH side shown, LH side similar.

Remove the two engine mount nuts.



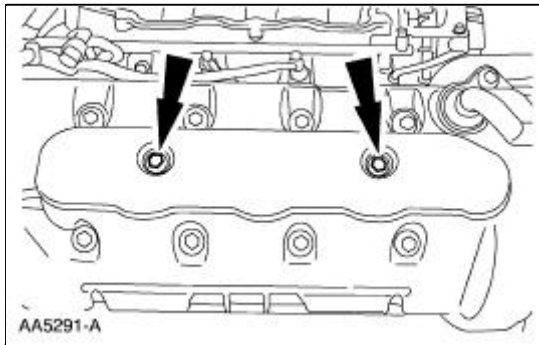
64. Lower the vehicle.

65. Remove the two screws and position the clutch cable aside.

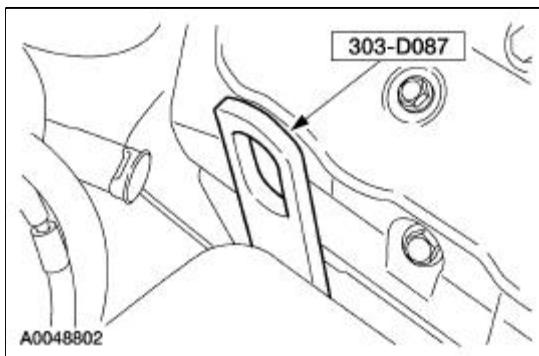


66. **NOTE:** RH is shown LH is similar.

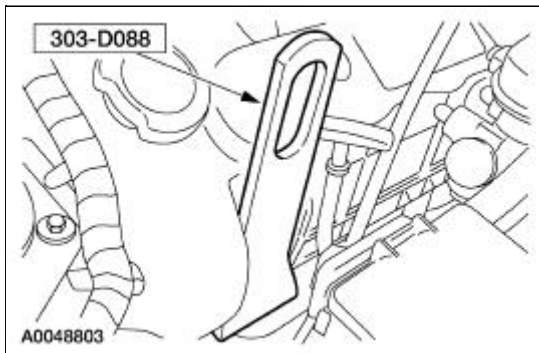
Remove the right and left ignition coil covers.



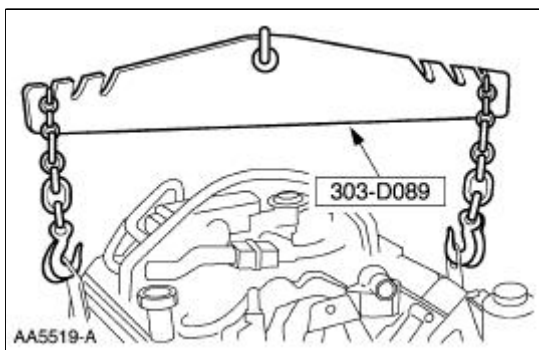
67. Install the special tool.



68. Install the special tool.

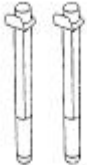


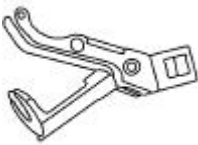
69. Attach the special tool to a floor crane and the engine, and remove the engine from the vehicle.



Engine

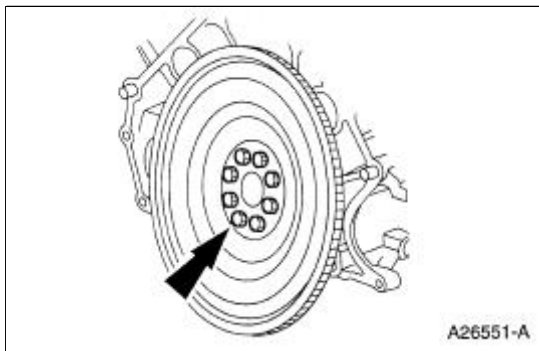
Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
 ST1718-A	Compressor, Valve Spring (Intake) 303-452 (T93P-6565-AR)
	Compressor, Valve Spring (Exhaust)

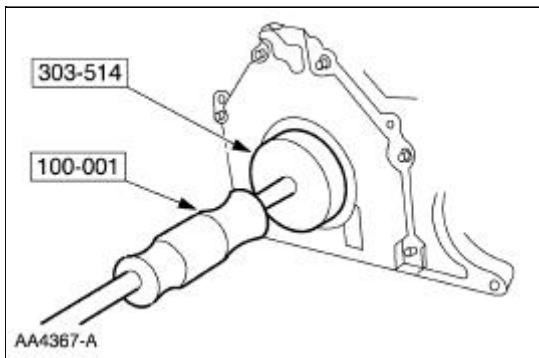
 ST1693-A	303-567 (T97P-6565-AH)
 ST1730-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)

Disassembly

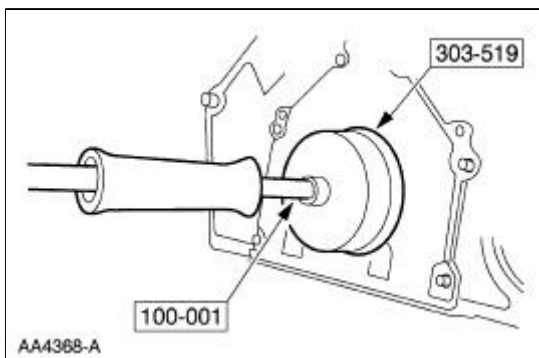
1. Remove the bolts and the flywheel.



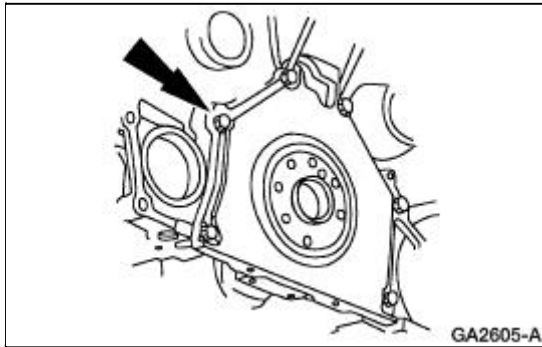
2. Using the special tool, remove the rear oil slinger.



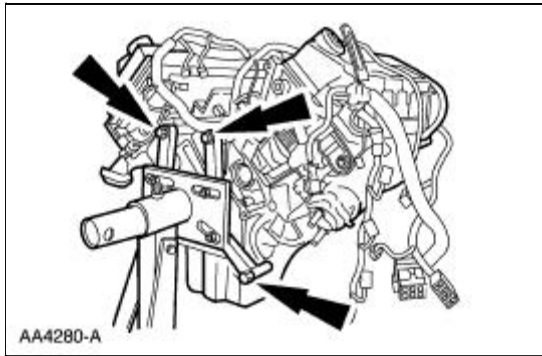
3. Using the special tool, remove the rear main seal.



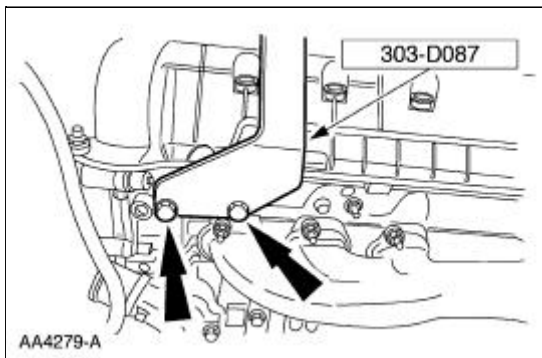
4. Remove the bolts and the rear seal retainer plate.



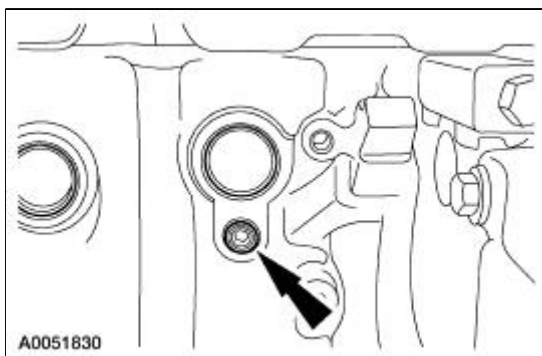
5. Mount the engine on a workstand.



6. Remove the special tools.

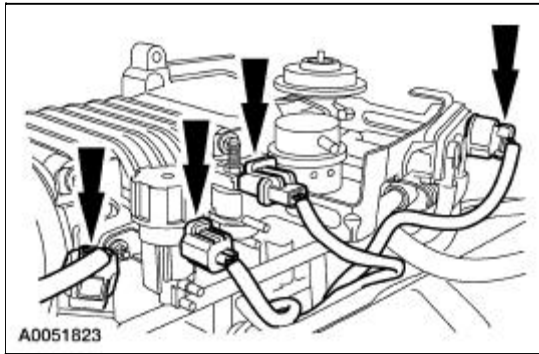


7. Remove the drain plug and drain the engine coolant.

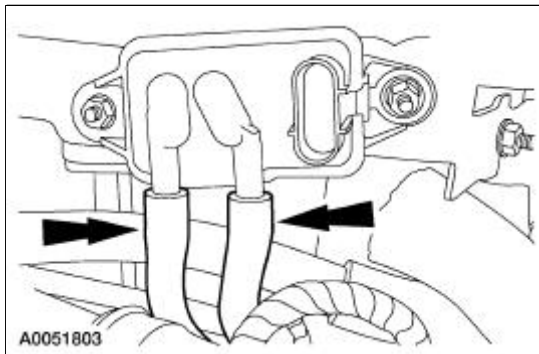


8. Disconnect the electrical connectors from the fuel pulse damper, exhaust gas recirculation (EGR) vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential

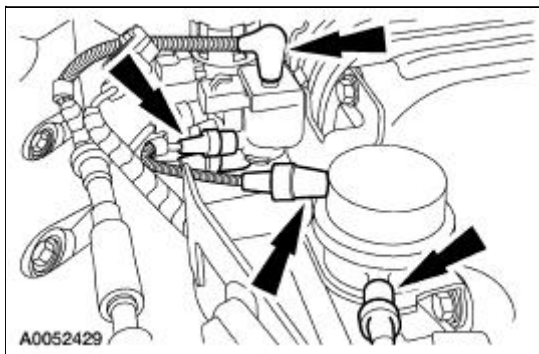
pressure feedback EGR system.



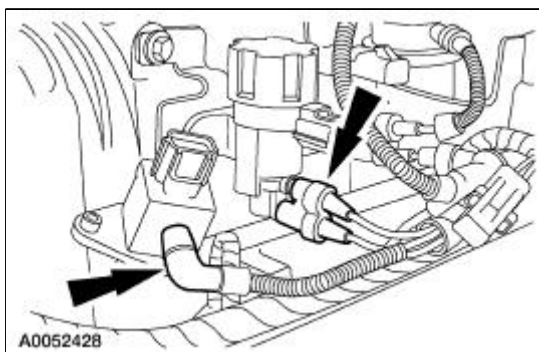
9. Disconnect the vacuum hoses from the differential pressure feedback EGR system.



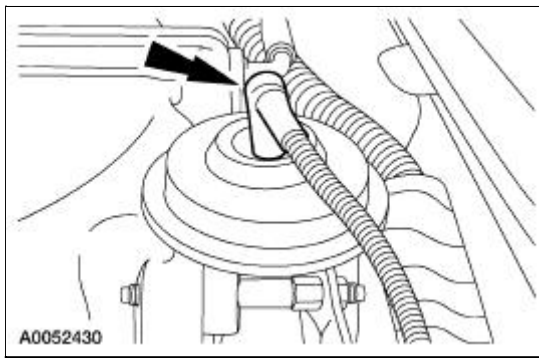
10. Disconnect the vacuum hoses from the supercharger bypass vacuum solenoid and the actuator.



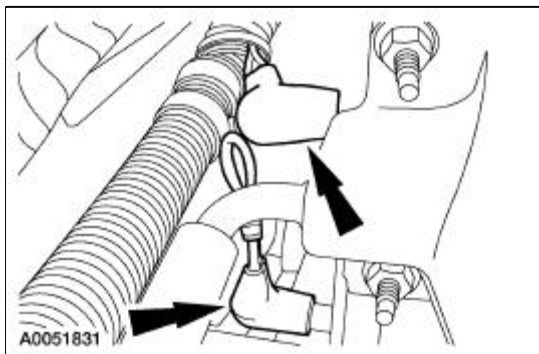
11. Disconnect the vacuum hoses from the fuel pulse damper and the EGR vacuum regulator solenoid.



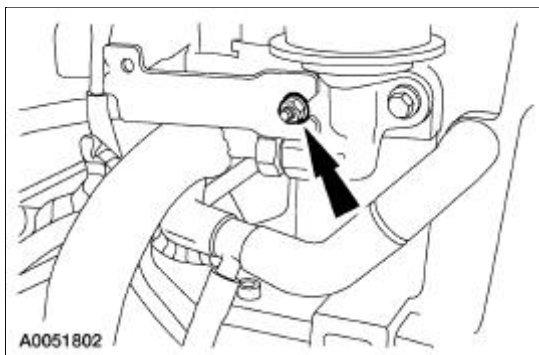
12. Disconnect the vacuum hose from the EGR valve.



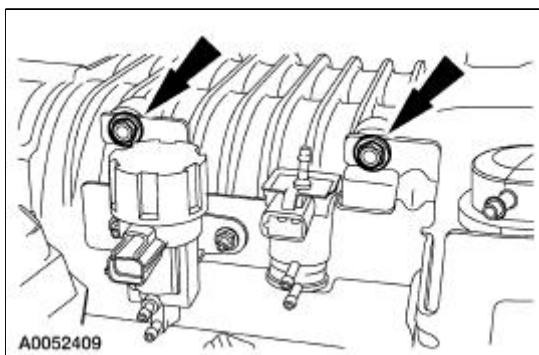
13. Disconnect the vacuum hoses at the back of the supercharger and remove the vacuum harness.



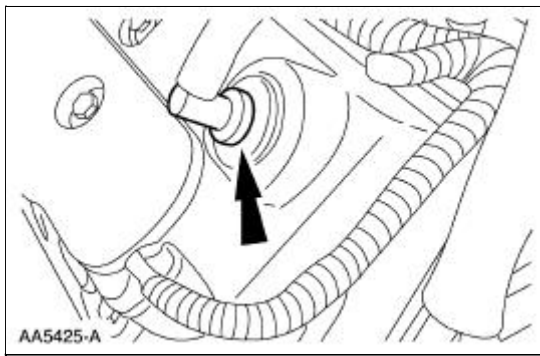
14. Remove the vacuum accessory bracket mounting nut.



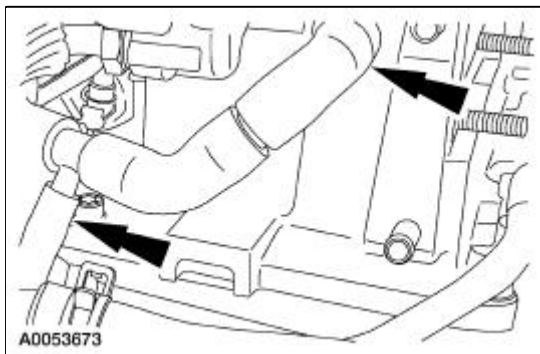
15. Remove the mounting bolts and the vacuum accessory bracket.



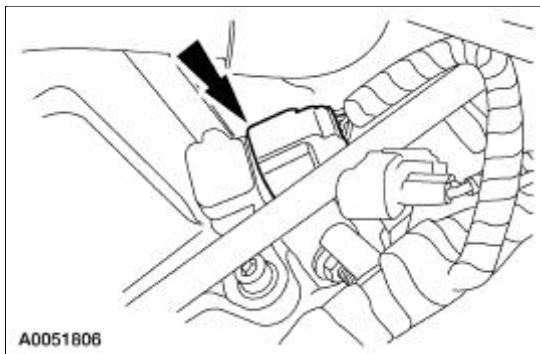
16. Remove the positive crankcase ventilation (PCV) valve.



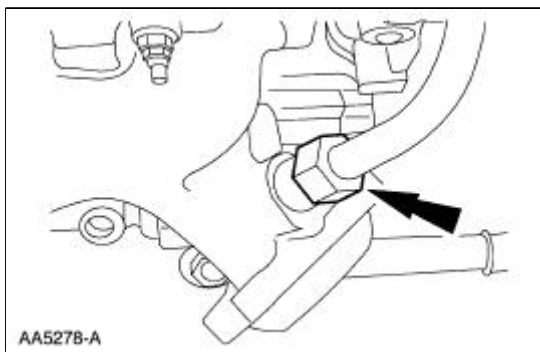
17. Disconnect and remove the PCV hose.



18. Disconnect the barometric pressure (BARO) sensor electrical connector.

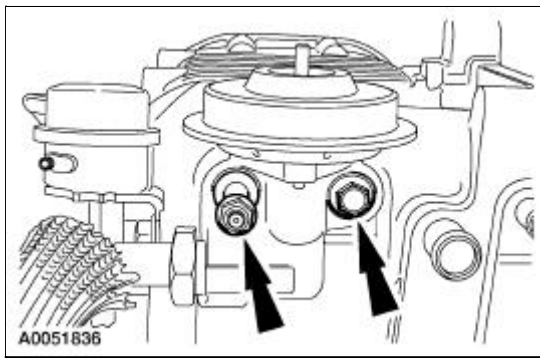


19. Disconnect the EGR tube from the exhaust manifold.

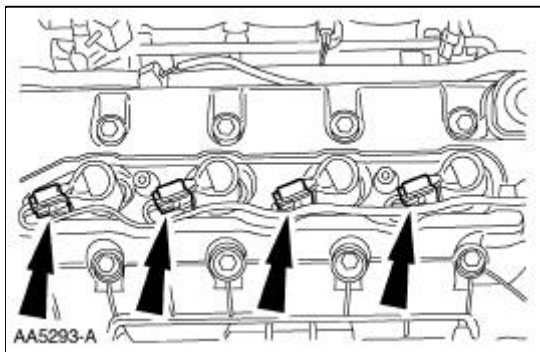


20. **NOTE:** Discard the EGR valve gasket.

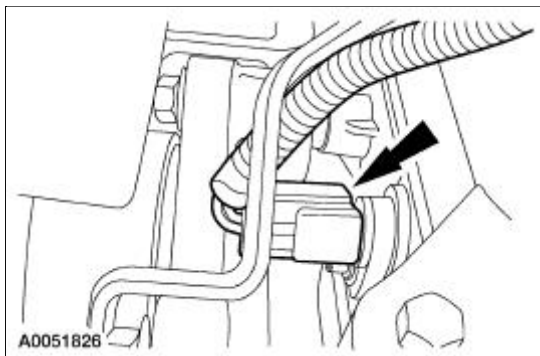
Remove the EGR valve and tube as an assembly.



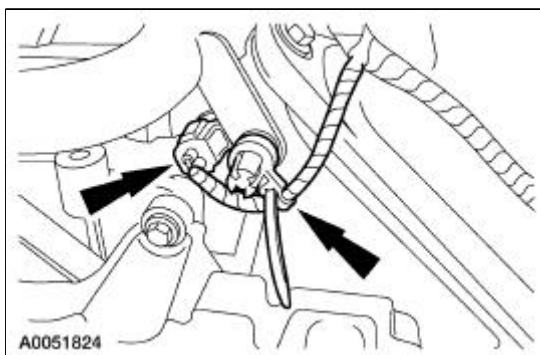
21. Disconnect the electrical connectors and remove the LH ignition coils.



22. Disconnect the camshaft position (CMP) sensor electrical connector.

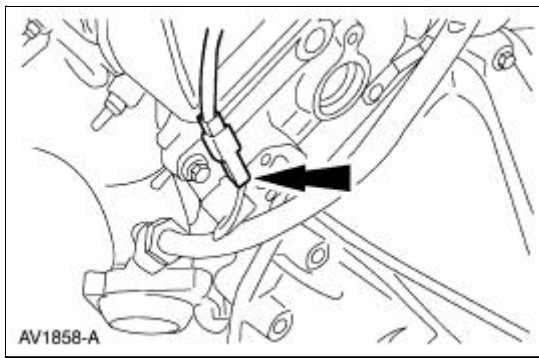


23. Disconnect the engine coolant temperature (ECT) sensor electrical connector and unclip the harness from the stud.

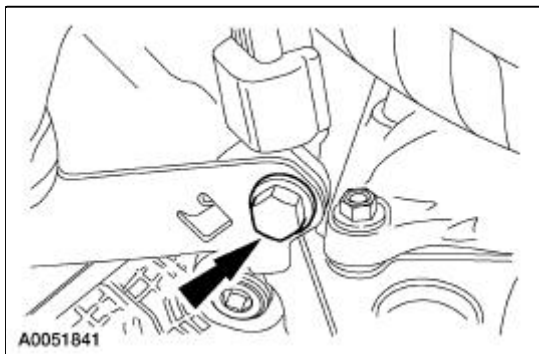


24. **NOTE:** LH is shown, RH is similar.

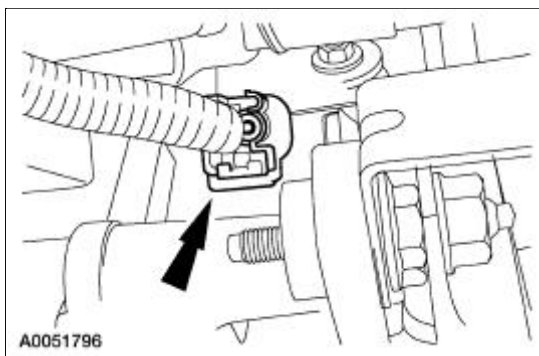
Disconnect the two radio ignition interference capacitor electrical connectors.



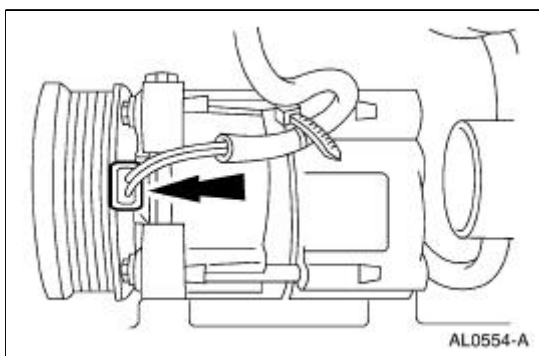
25. Remove the fuel charging wiring harness bracket bolt.



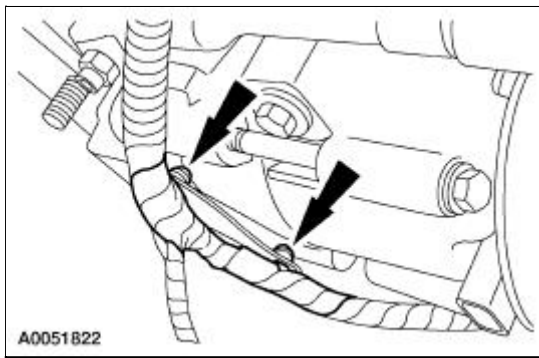
26. Disconnect the crankshaft position (CKP) sensor electrical connector.



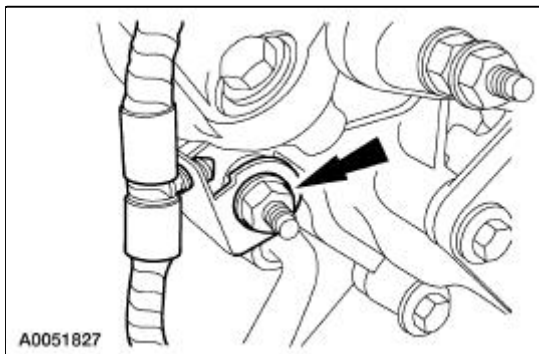
27. Disconnect the A/C compressor electrical connector.



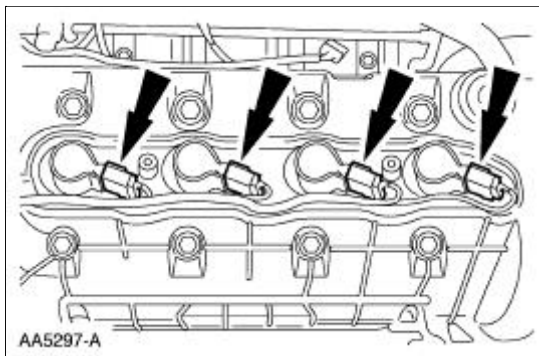
28. Unclip the harness from the bracket.



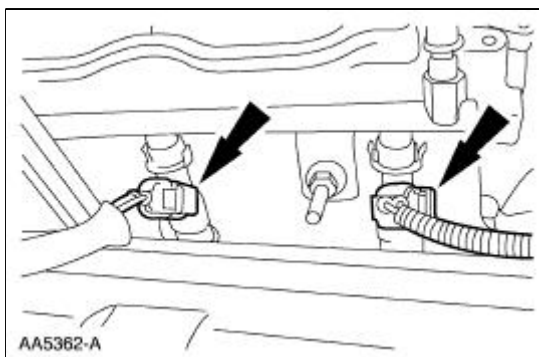
29. Remove the harness support bracket.



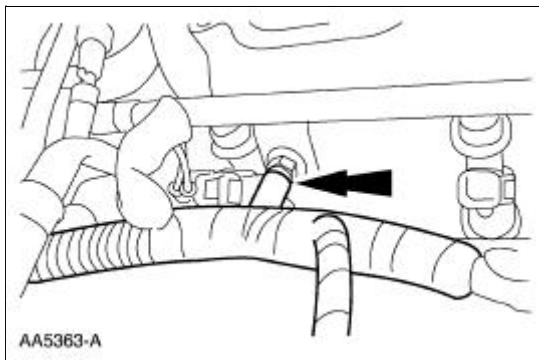
30. Disconnect the electrical connectors and remove the RH ignition coils.



31. Disconnect the eight fuel injectors.

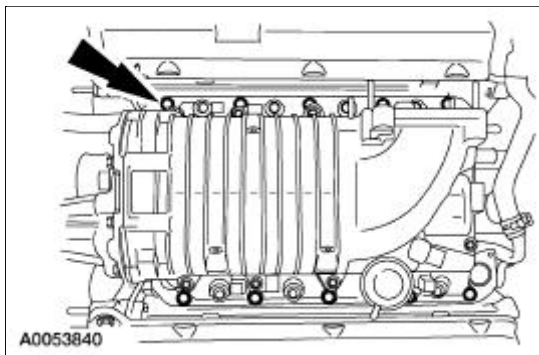


32. Separate the harness from the fuel supply manifold studs in four places and remove the fuel charging wiring harness.

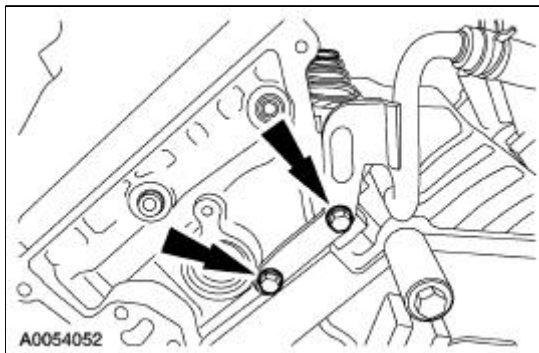


33. **NOTE:** The intake manifold gaskets are reusable if undamaged.

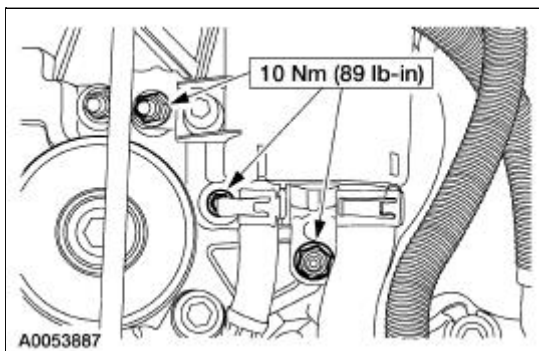
Remove the ten bolts and the intake manifold, and the supercharger and fuel supply manifold as an assembly.



34. Remove the bolts and the heater water outlet tube.

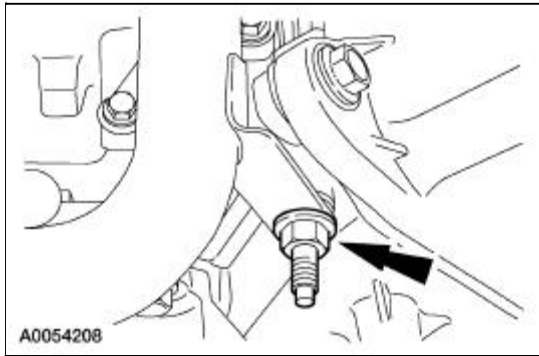


35. Remove the bolts and the heater water inlet tube.



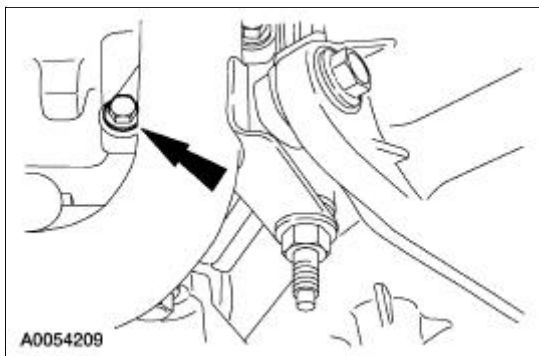
36. **NOTE:** LH is shown, RH is similar.

Remove the coolant bypass studs.

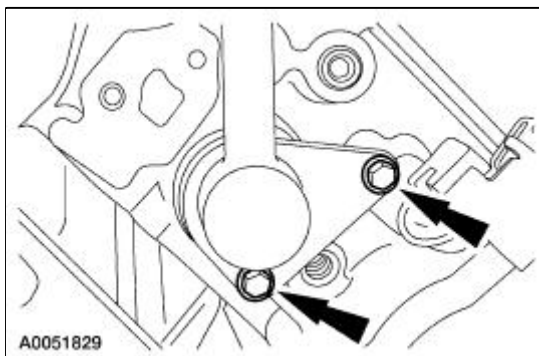


37. **NOTE:** LH is shown, RH is similar.

Remove the bolts and the coolant bypass tube.



38. Remove the bolts and the heater water inlet tube.

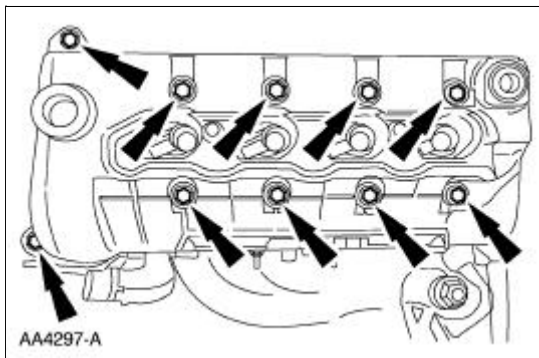


39.  **CAUTION:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

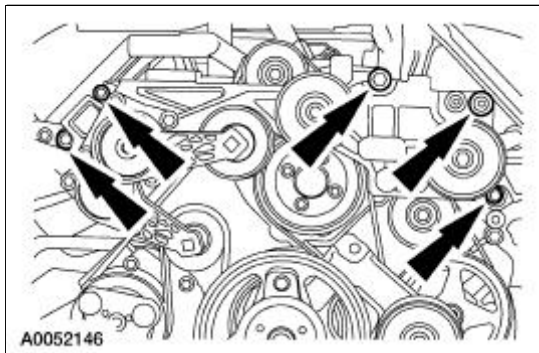
NOTE: LH is shown, RH is similar.

Remove the fasteners and the LH and RH valve covers.

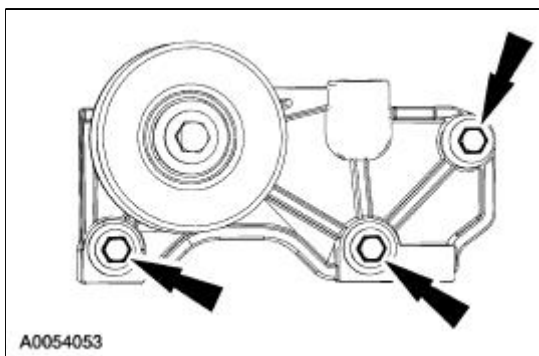
- Remove and discard the gasket, clean and inspect the sealing surfaces.



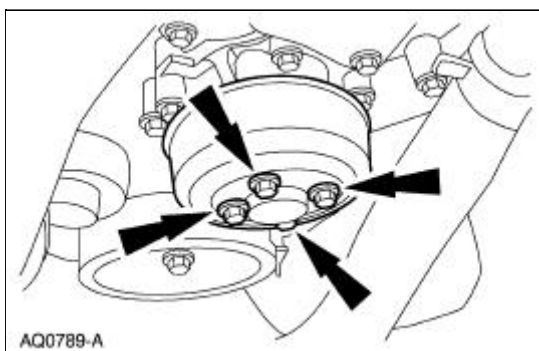
40. Remove the supercharger belt idler support bracket assembly.



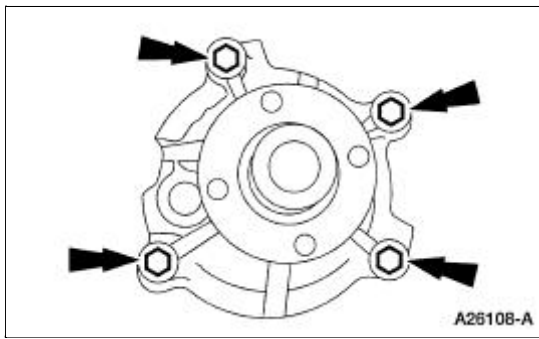
41. Remove the accessory drive belt.
42. Remove the bolts and belt idler bracket.



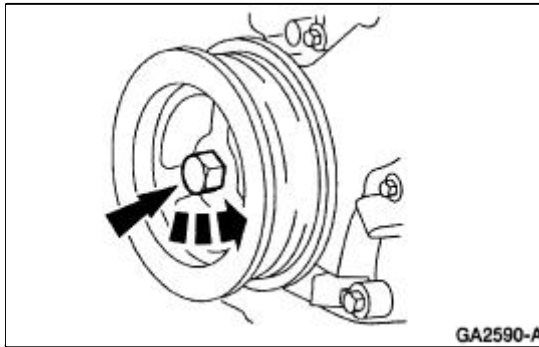
43. Remove the bolts and the water pump pulley.



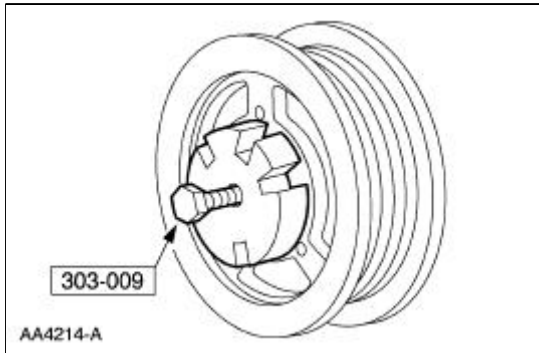
44. Remove the water pump from the cylinder block.
 - Inspect and clean the sealing surfaces.



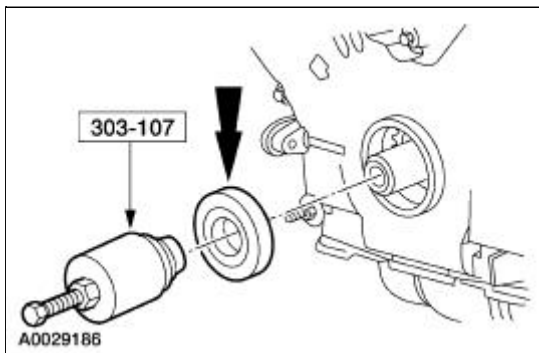
45. Remove the bolt.



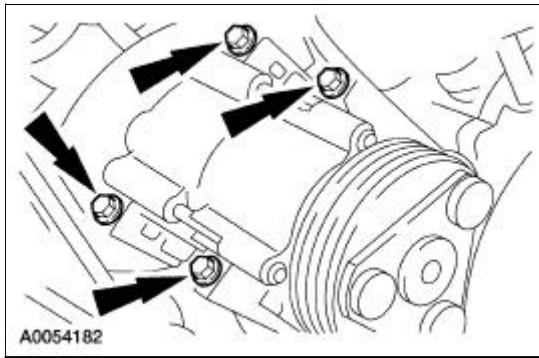
46. Using the special tool, remove the crankshaft pulley.



47. Using the special tools, remove the crankshaft front seal.



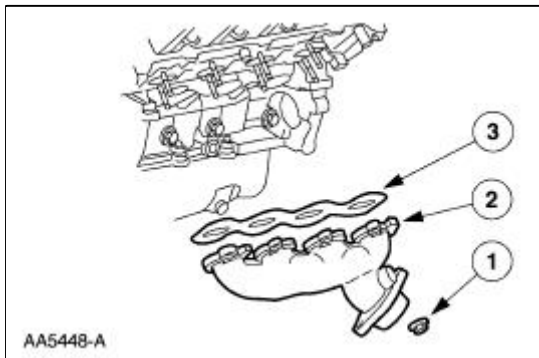
48. Remove the bolts and the A/C compressor.



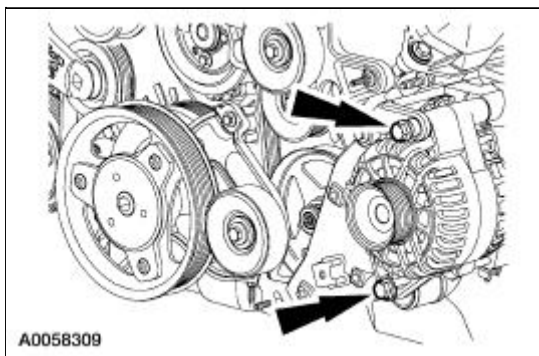
49. **NOTE:** LH is shown; RH is similar.

Remove the exhaust manifold.

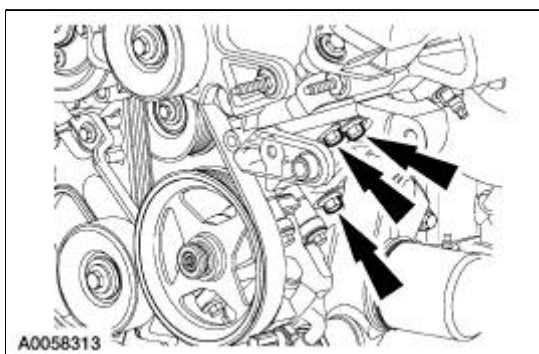
1. Remove the nuts.
2. Remove the exhaust manifold.
3. Remove and discard the exhaust manifold gasket.



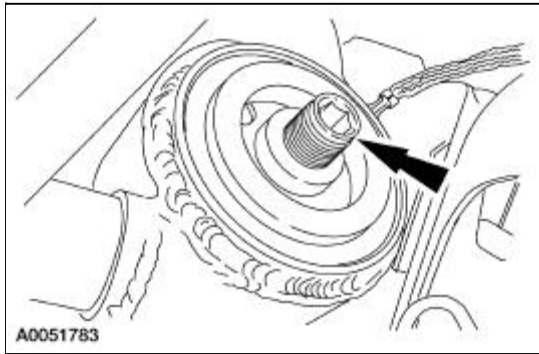
50. Remove the bolts and the generator.



51. Remove the bolts and the generator support bracket.

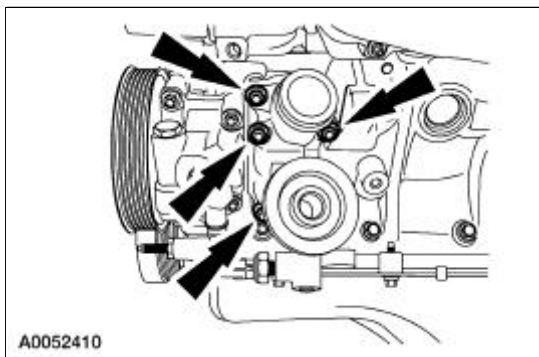


52. Remove the oil cooler.



53. Remove the bolts, the oil filter adapter and the gasket.

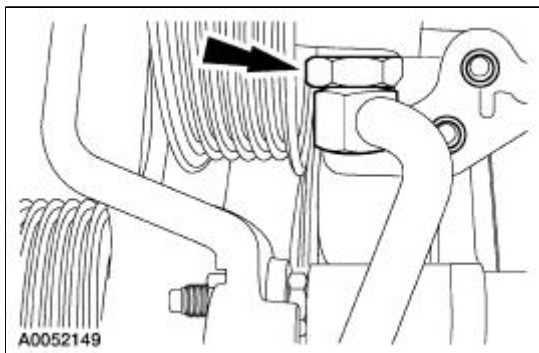
- Discard the gasket.



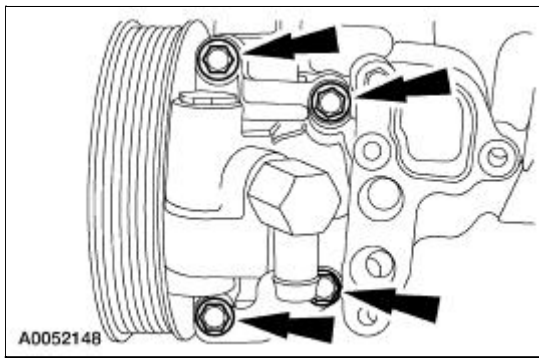
54. Clean and inspect the oil filter adapter and the oil cooler.

- Plug the oil cooler coolant lines.
- Flush the adapter and cooler with parts cleaner. If metal particles are present, install a new oil filter adapter and oil cooler.

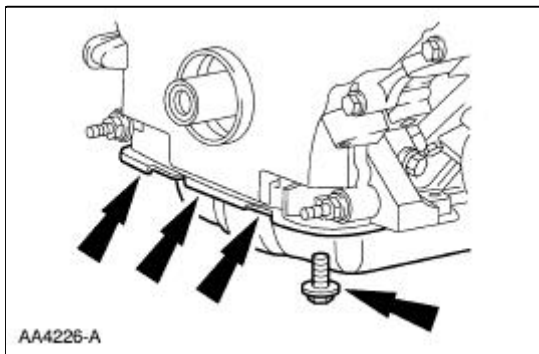
55. Remove the power steering pressure hose.



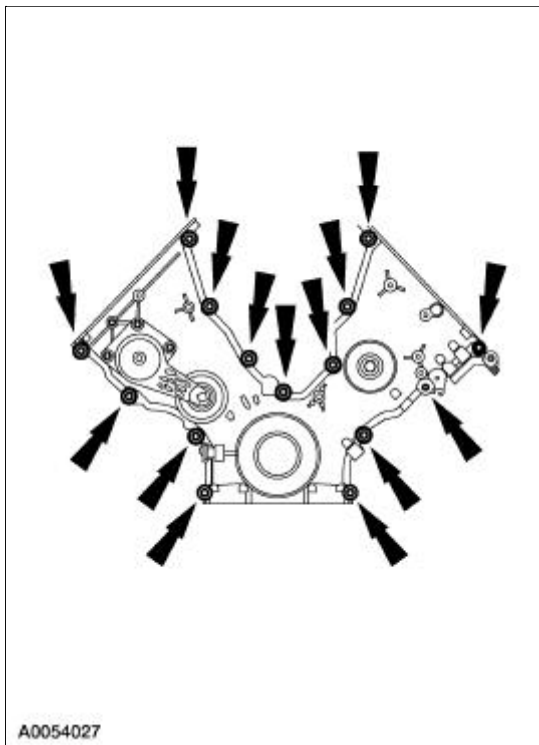
56. Remove the bolts and the power steering pump.



57. Remove the four bolts.

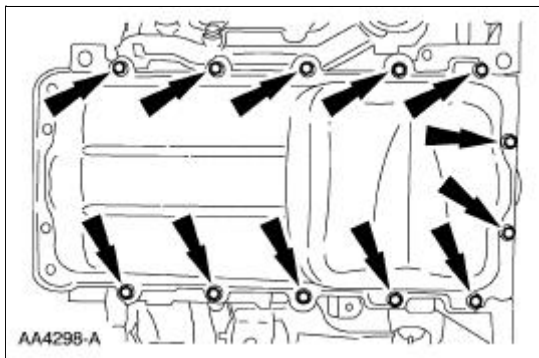


58. Remove the bolts, the studs, and the engine front cover.

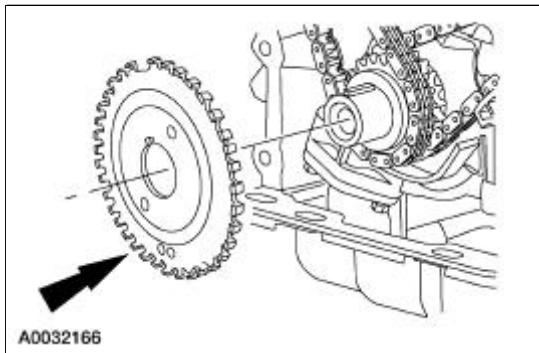


59. **NOTE:** The oil pan gasket is reusable if not damaged. Inspect the gasket and install new if necessary.

Remove the bolts, the oil pan, and the gasket.

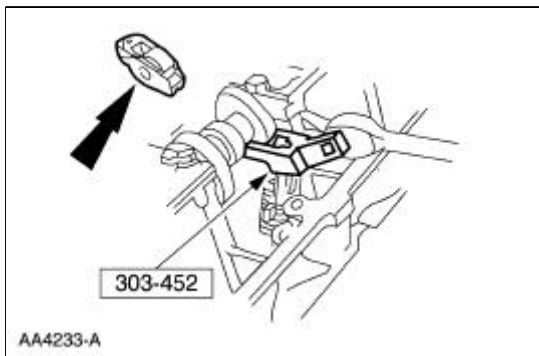


60. Remove the crankshaft position sensor pulse wheel.

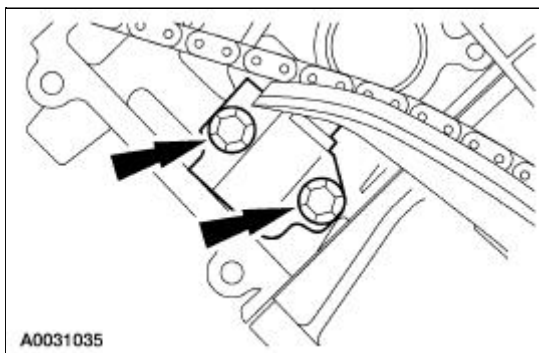


61. **NOTE:** Make sure the base circle of the camshaft is facing the roller follower being removed.

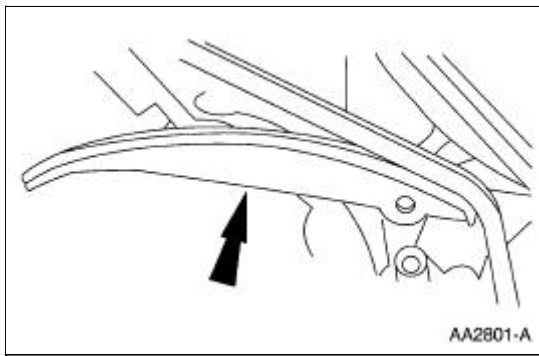
Using the special tool, remove the 32 roller followers.



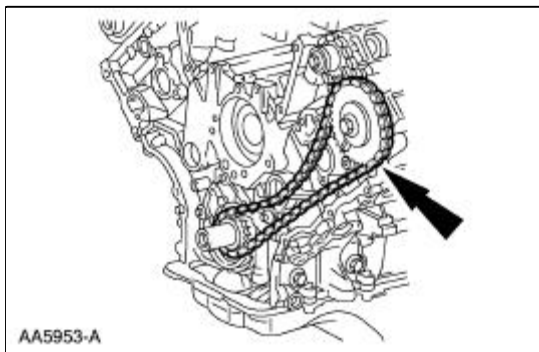
62. Remove the bolts and the RH and LH timing chain tensioners.



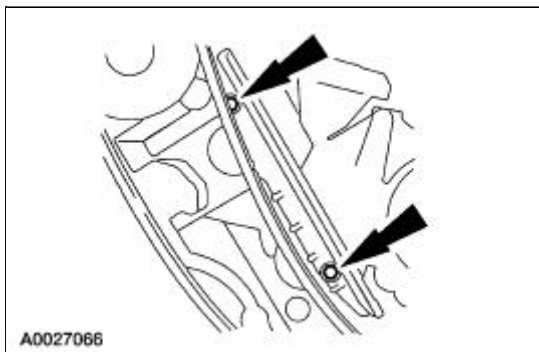
63. Remove the RH and LH timing chain tensioner arms.



64. Remove the RH and the LH timing chains and the crankshaft sprocket.

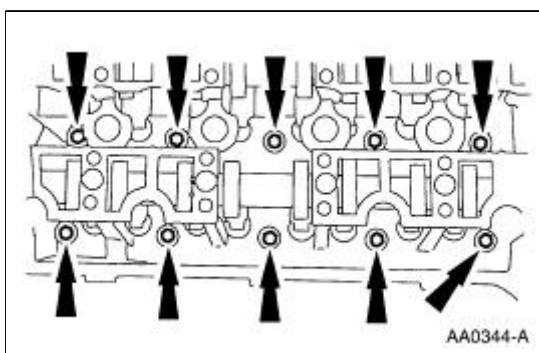


65. Remove the bolts and the RH and LH timing chain guides.

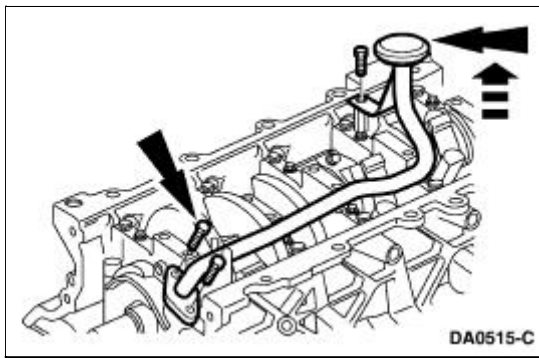


66. **NOTE:** Cylinder head bolts are not to be reused. Discard the bolts.

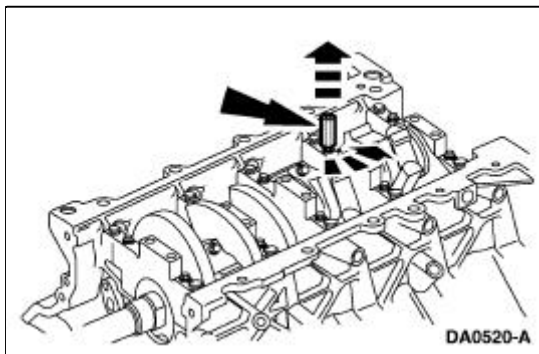
Remove the bolts and the RH and LH cylinder heads.



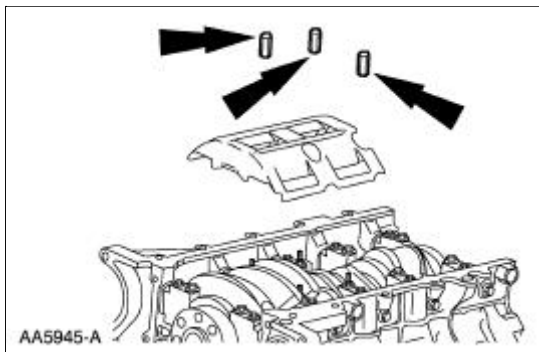
67. Remove the bolts and the oil pump screen and pickup tube (6622).



68. Remove the oil pump screen and pickup tube spacer.

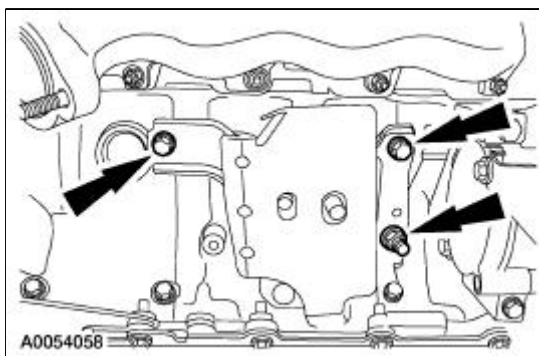


69. Remove the spacers and the windage tray.

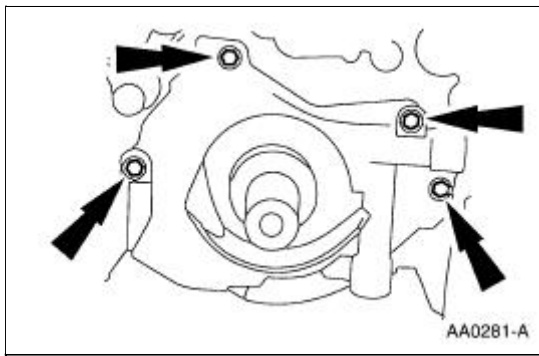


70. **NOTE:** RH is shown, LH is similar.

Remove the RH and LH engine mounts.



71. Remove the bolts and remove the oil pump.

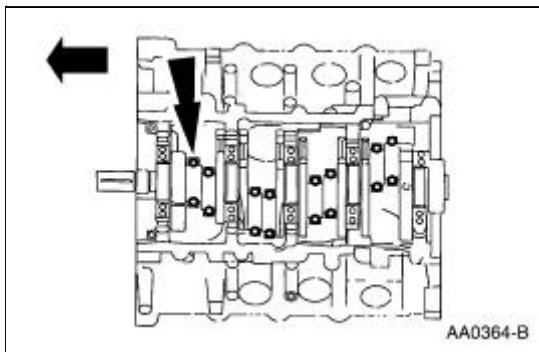


72.  **CAUTION: Do not stamp the top of pistons, as ring land damage can occur.**

NOTE: Connecting rods and rod caps should be numbered to keep the correct orientation in the following sequence.

Remove the connecting rod caps for pistons number 1 and 6.

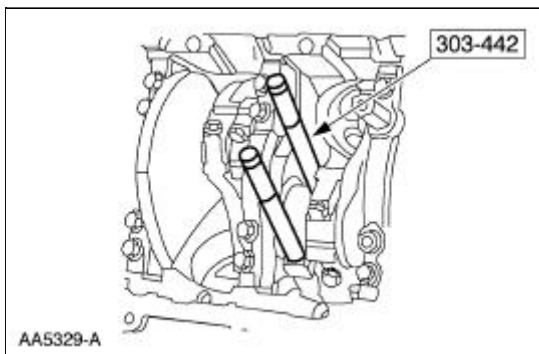
- Discard the bolts.



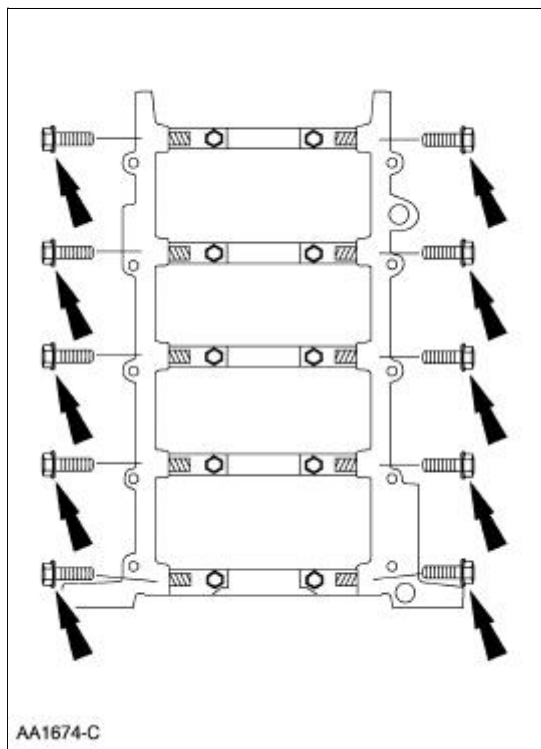
73.  **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

NOTE: Before removing pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using a cylinder ridge reamer. Follow manufacturer's instructions.

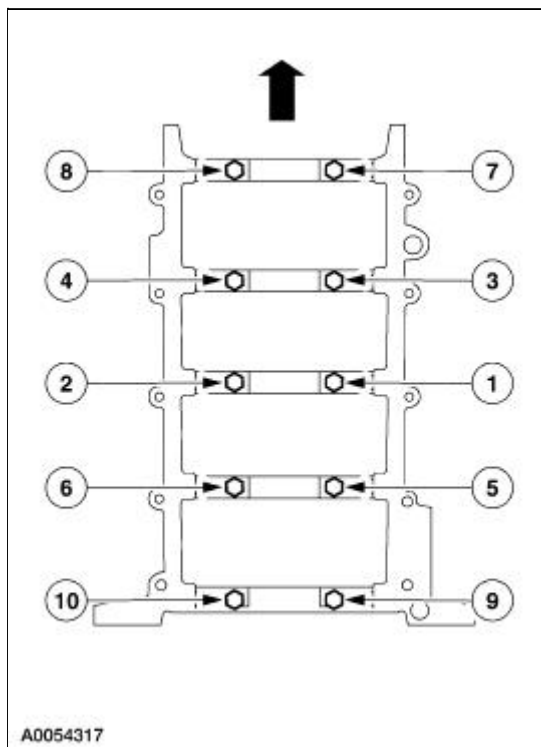
Using the special tool, push pistons number 1 and 6 through the top of the cylinder block.



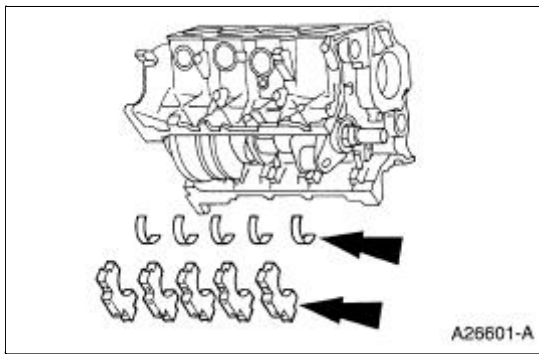
74. To remove pistons number 3 and 5, 4 and 7, 2 and 8, turn the crankshaft 90 degrees and repeat the previous two steps.
75. Remove the side bolts.



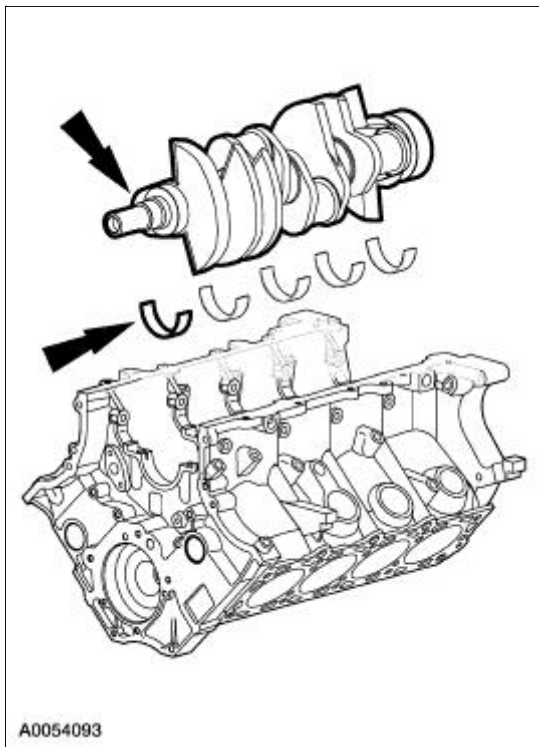
76. Remove and discard the bolts.



77. Remove the main bearing caps and the crankshaft lower main bearings from the cylinder block.

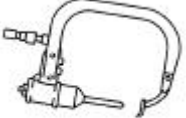


78. Remove the crankshaft, the crankshaft thrust washer, and the crankshaft upper main bearings from the cylinder block.



Cylinder Head

Special Tool(s)

 ST2373-A	Compressor, Valve Spring (Exhaust Side) 303-567 (T97P-6565-AH)
 ST1718-A	Compressor, Valve Spring (Intake Side) 303-452 (T93P-6565-AR)
 ST1715-A	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)
 ST1716-A	Air Operated Valve Spring Holder 134-R0207 or equivalent
 ST1332-A	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)

Material

Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153- H

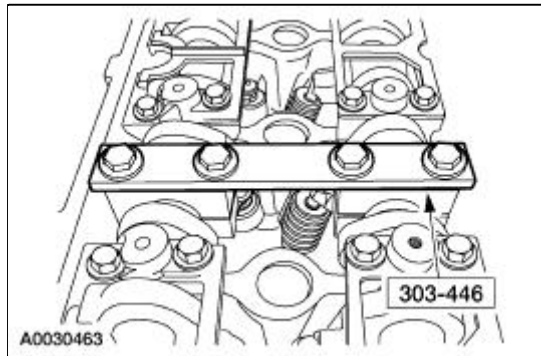
Disassembly

1.  **CAUTION:** Do not place the cylinder head (6049) flat on the bench; the valves will bend.

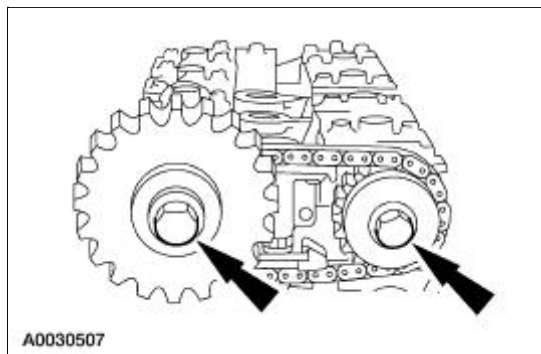
 **CAUTION:** Before disassembly begins, mark the valve position on the face of each

valve being removed. The valves must be re-installed into the same positions.

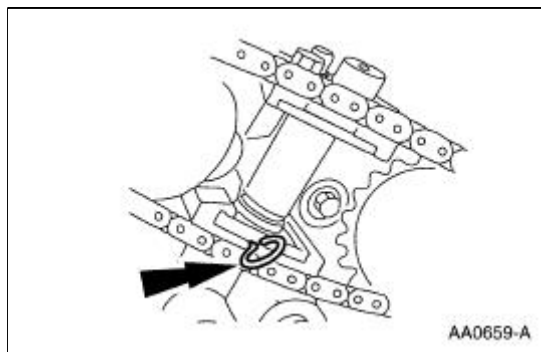
Install the special tool.



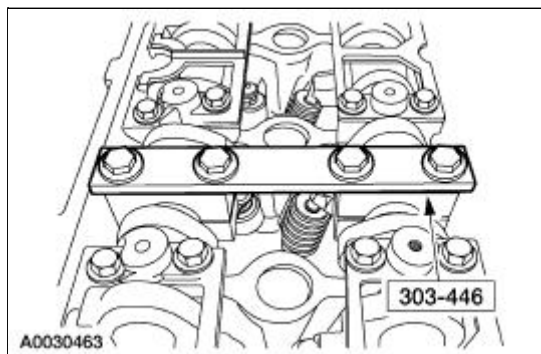
2. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.



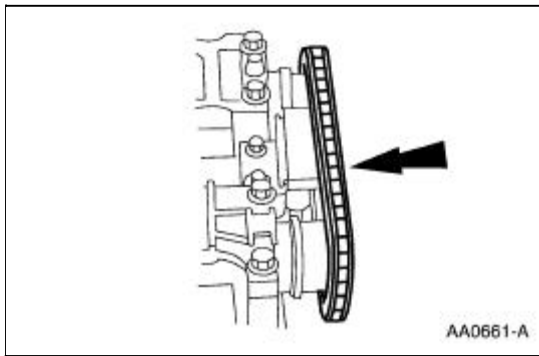
3. Compress the tensioner (6L266) and install a lock pin.



4. Remove the special tool.

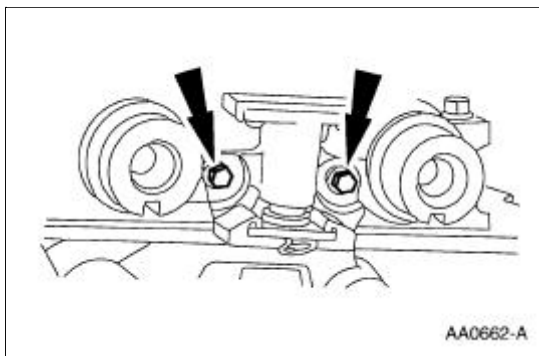


5. Remove the timing chain (6268) and the camshaft sprocket (6256).

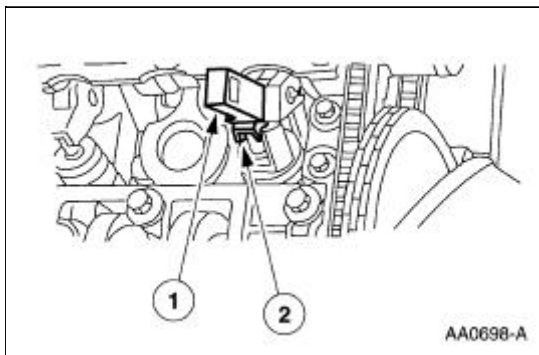


6. **NOTE:** LH tensioner is shown, RH tensioner is similar.

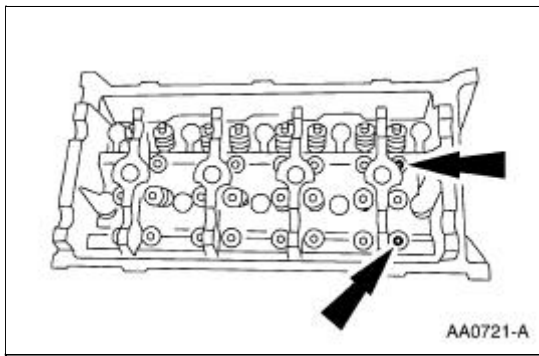
Remove the tensioner.



7. Remove the roller followers on the base circle.
1. Install the special tool on the valve spring.
 2. Compress the tool and remove the roller follower.

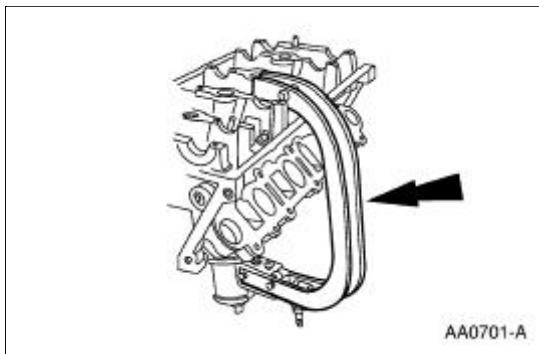


8. Repeat the previous step for the remaining roller followers.
9. Remove the hydraulic lash adjusters.

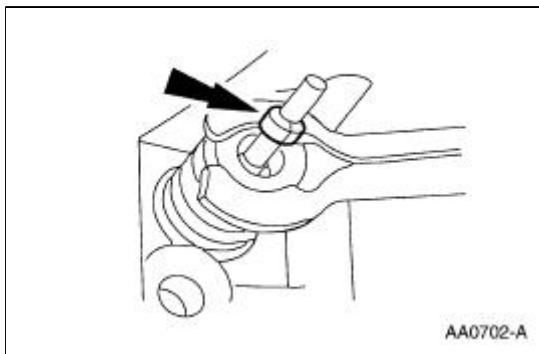


10.  **CAUTION:** Make sure the tool is seated correctly on the valve spring. Apply a small amount of air at a time. This will prevent the tool from shifting and causing damage to the cylinder head.

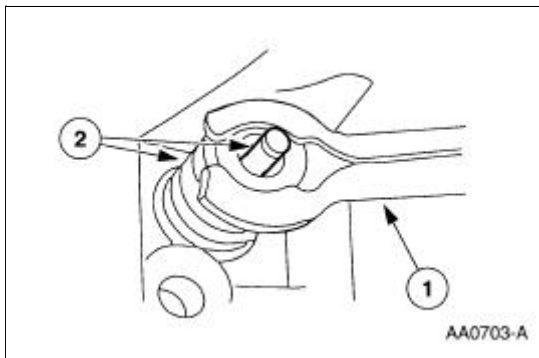
Install the air-operated spring compressor on the cylinder head.



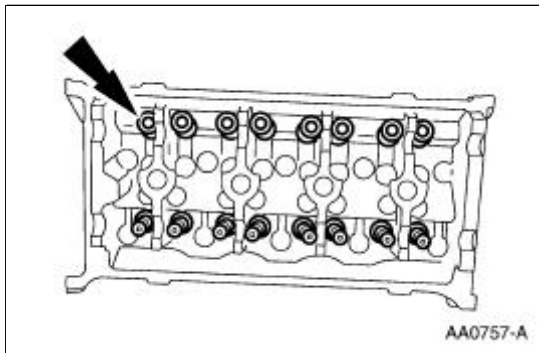
11. Compress the valve spring compressor and remove the key from the valves.



12. Remove the intake valves and the valve springs.
1. Release the pressure and remove the valve spring compressor.
 2. Remove the intake valves and the valve springs from the cylinder head.



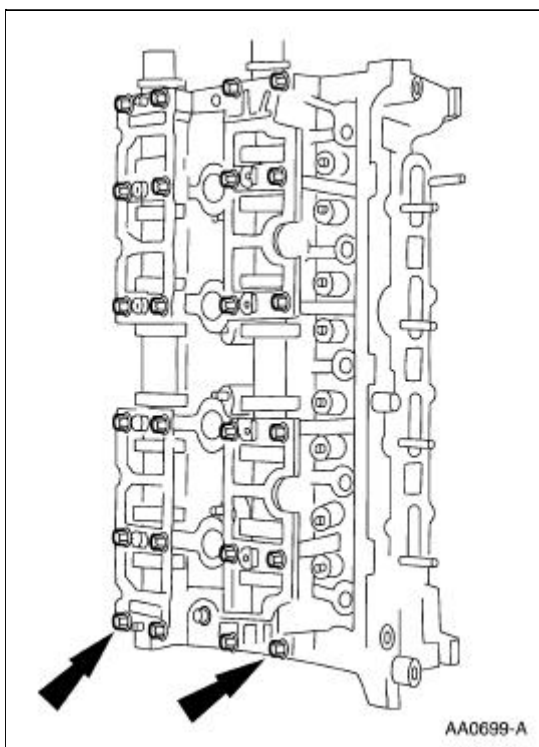
13. Remove the valve stem seals.



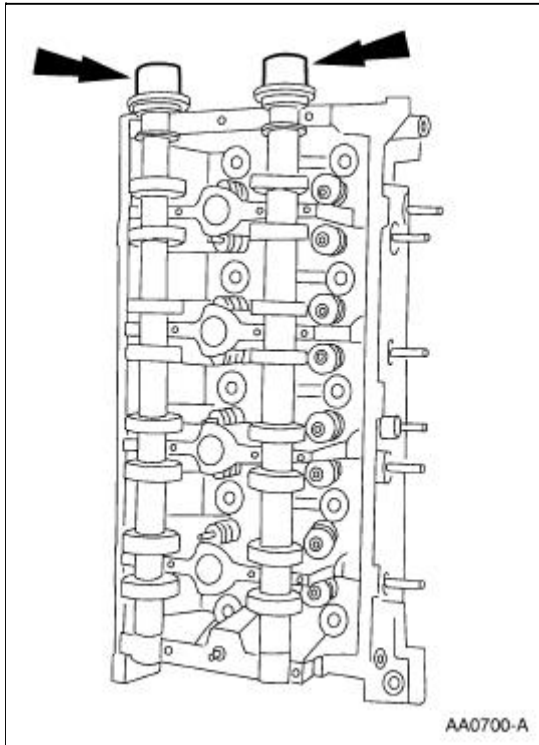
14.  **CAUTION:** The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.

NOTE: Identify the camshaft-to-cylinder head location. Caps are not interchangeable.

Remove the bolts and the camshaft bearing cap assemblies.

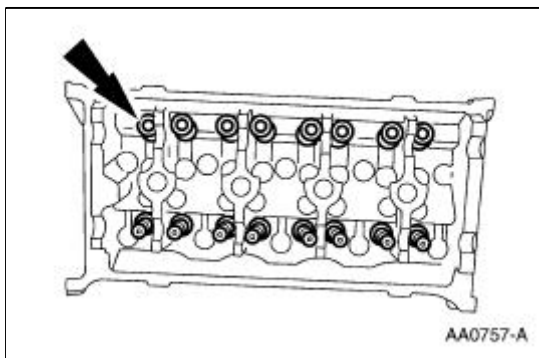


15. Remove the camshafts (6250).



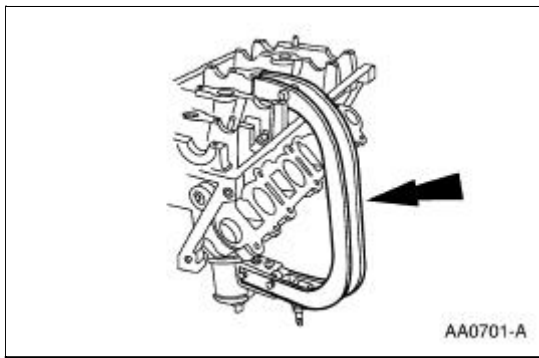
Assembly

1. Install the valve stem seals.

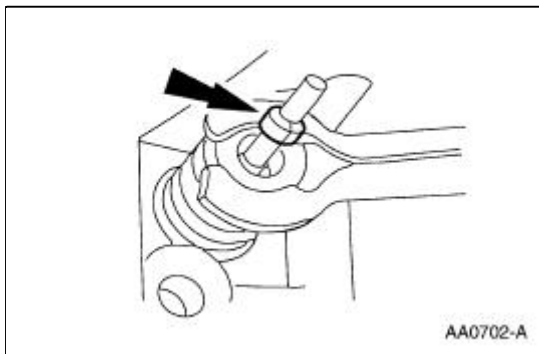


2. Install the valves and the valve springs.
3.  **CAUTION:** Make sure the tool is seated correctly on the valve spring. Apply a small amount of air at a time. This will prevent the tool from shifting and causing damage to the cylinder head.

Install the air-operated spring compressor on the cylinder head.



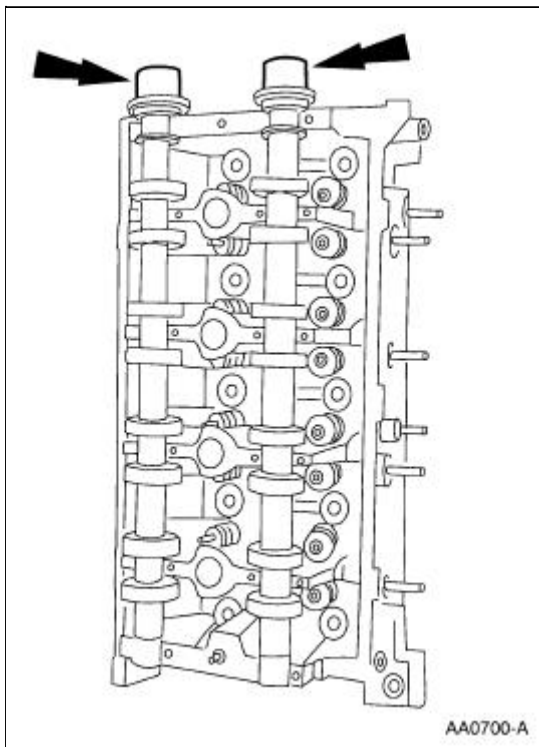
4. Compress the valve spring compressor and install the key on the valves.



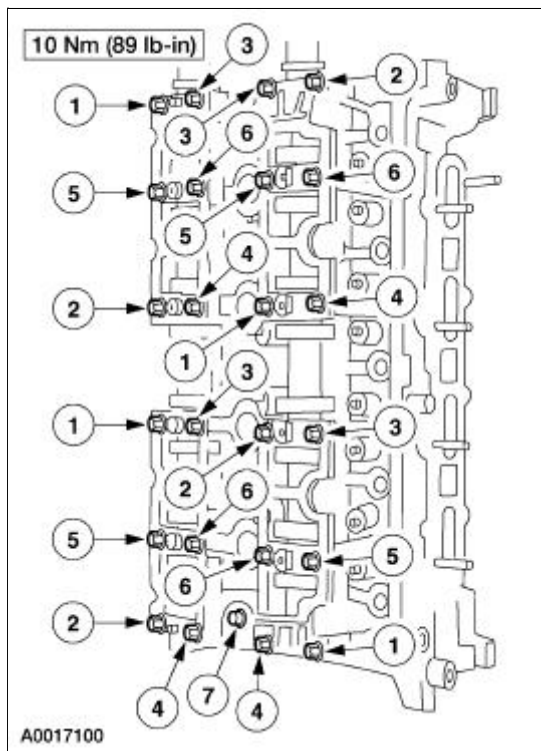
5. **NOTE:** LH is shown, RH is similar.

Install the camshafts.

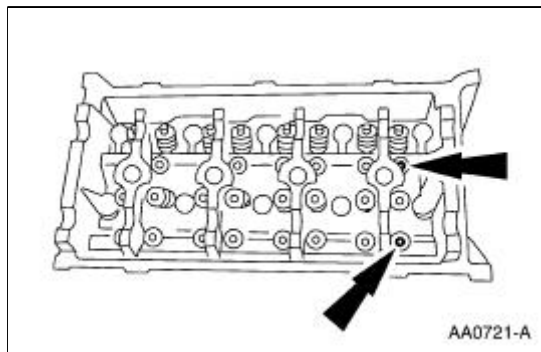
- Lubricate the camshafts with clean engine oil.



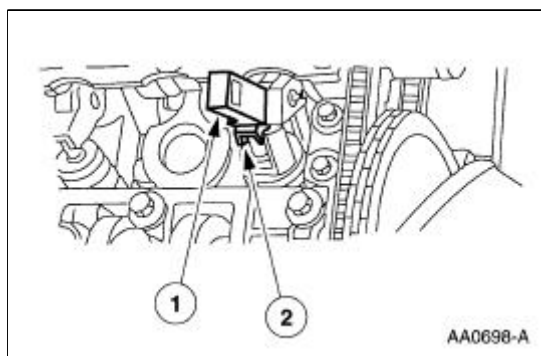
6. Install the camshaft bearing cap assemblies.



7. Install the hydraulic lash adjusters.

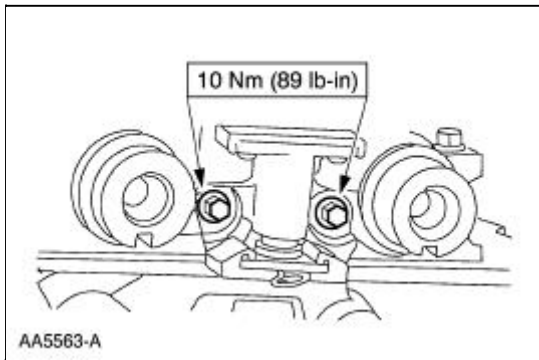


8. Install the roller followers.
 1. Install the special tool on the valve spring.
 2. Compress the spring and install the roller follower.



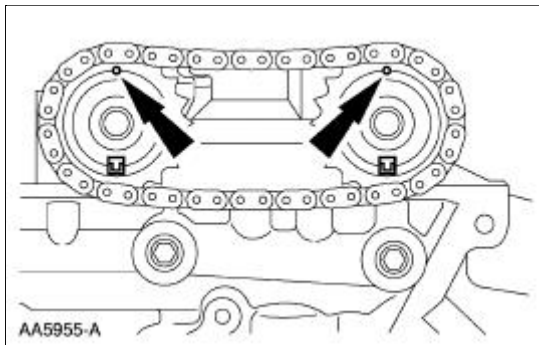
9. Repeat the previous step for the remaining roller followers.
10. **NOTE:** LH tensioner is shown, RH tensioner is similar.

Install the tensioner.

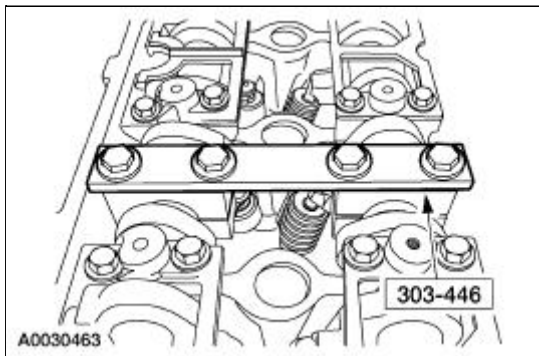


11.  **CAUTION:** Timing marks must be at 12 o'clock and indexed at 6 o'clock.

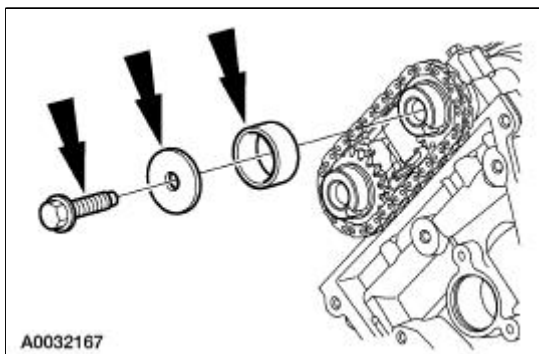
Install the camshaft sprockets and the chain as an assembly.



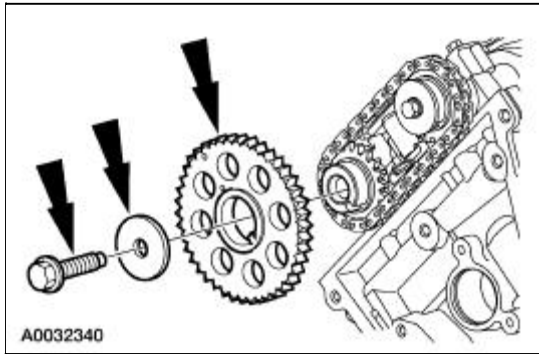
12. Install the special tool.



13. Install the camshaft spacer, washer and bolt, and hand-tighten the bolt.

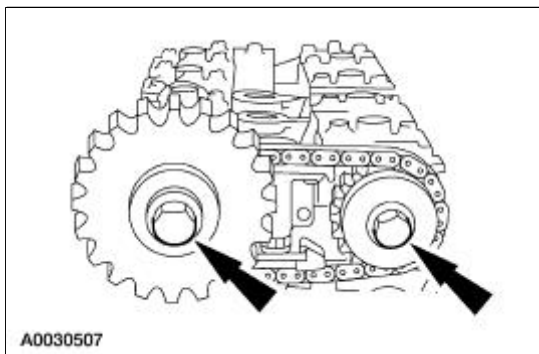


14. Install the camshaft sprocket, washer and bolt, and hand-tighten the bolt.

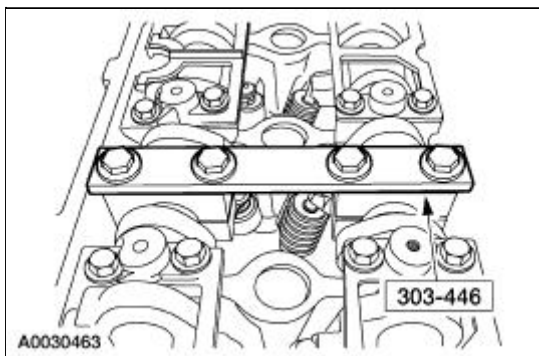


15. Tighten the bolts in two stages:

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten and additional 90 degrees.



16. Remove the special tool.



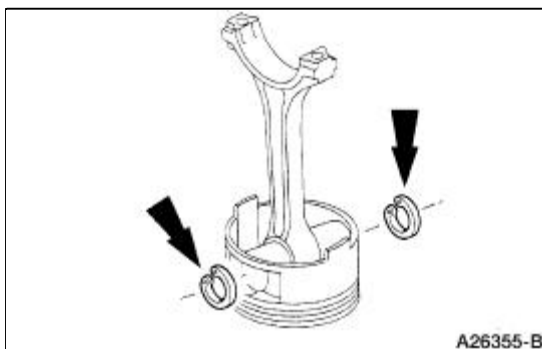
Piston

Material

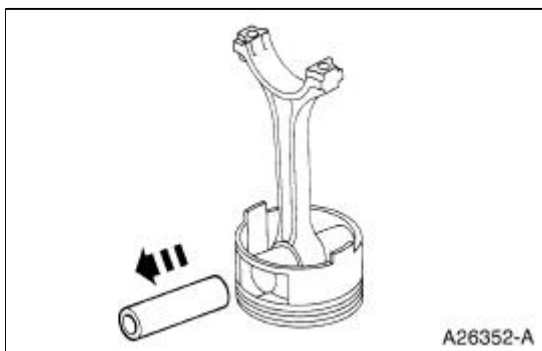
Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP	WSS-M2C153- H

Disassembly

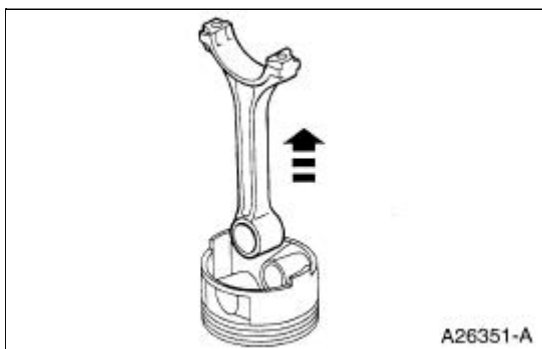
1. Remove the clips.



2. Remove the piston pin (6135) from the piston (6108) and connecting rod assembly.



3. Remove the connecting rod (6200) from the piston.

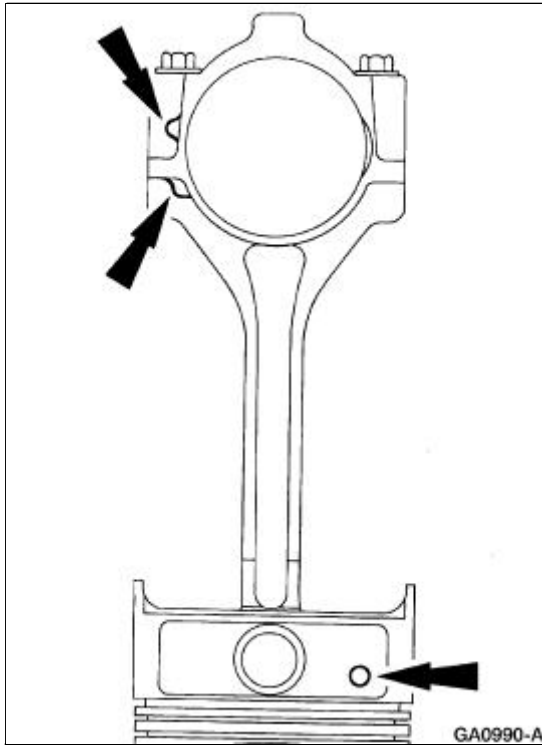


4. Clean and inspect the piston and connecting rod. For additional information, refer to [Section 303-00](#).

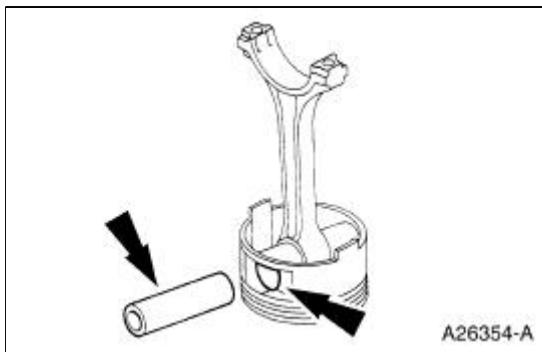
Assembly

1. **NOTE:** Connecting rod must be installed into piston with identification markings toward front.

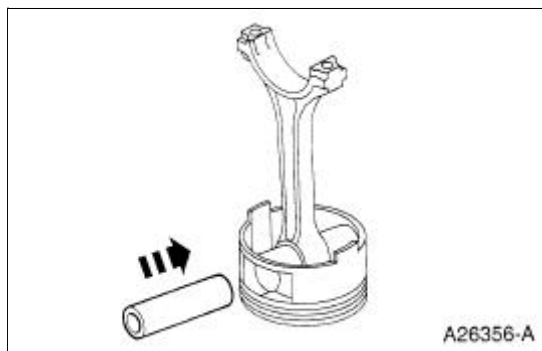
Position the connecting rod in the piston.



2. Lubricate the piston pin and pin bore with clean engine oil.



3. Install the piston pin in the piston and connecting rod assembly.



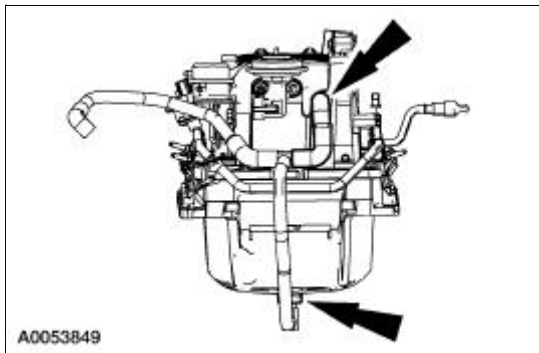
4. Install the piston pin retaining clips in the piston.



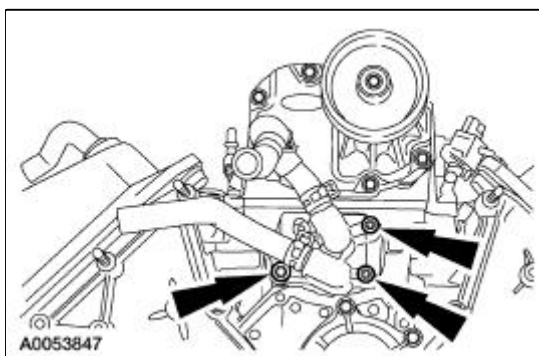
Intake Manifold Assembly

Disassembly and Assembly

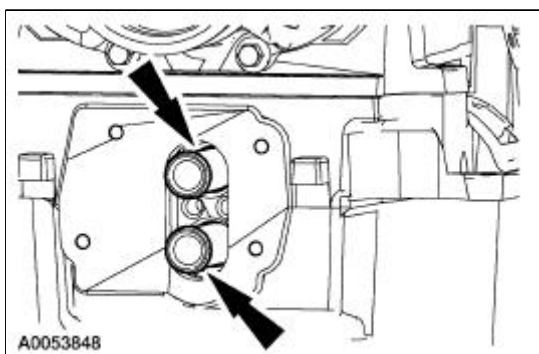
1. Disconnect and remove the PCV hoses.



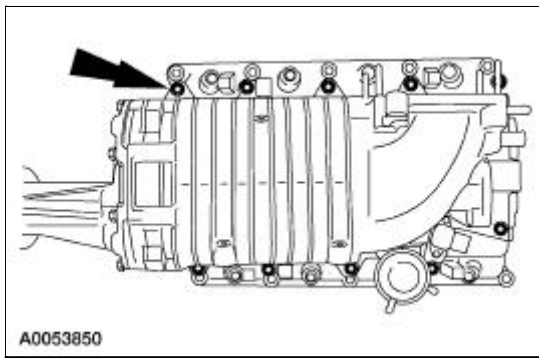
2. Remove the coolant supply and return manifold.



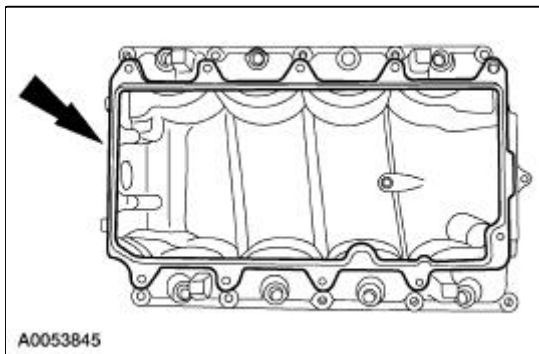
3. Remove the coolant supply and return tubes and seals.



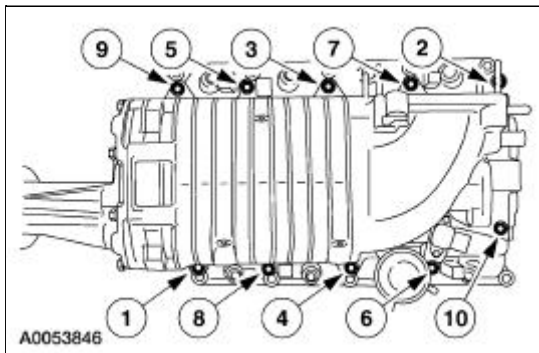
4. Remove the bolts, the supercharger and the charge air cooler (CAC) assembly.



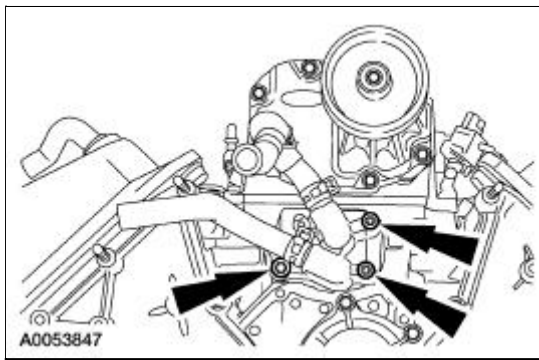
5. Inspect the CAC plenum gasket and install a new gasket if necessary.



6. To assemble, reverse the disassembly procedure
7. Tighten the supercharger and CAC cooler assembly-to-lower intake manifold bolts, in the sequence shown, in two stages.
 1. Stage 1: Tighten to 2 Nm (18 lb-in).
 2. Stage 2: Tighten to 25 Nm (18 lb-ft).

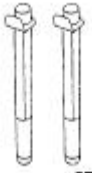
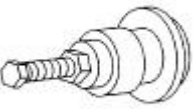


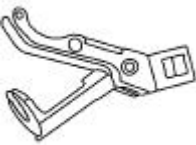
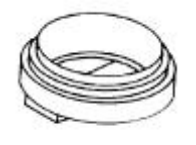
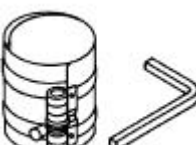
8. Tighten the coolant supply and return manifold in two stages.
 1. Stage 1: Tighten to 10 Nm (89 lb-ft).
 2. Stage 2: Tighten an additional 90 degrees.



Engine

Special Tool(s)

 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST2197-A	Installer, Crankshaft Front Oil Seal 303-635
 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
 ST1482-A	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
 ST1718-A	Compressor, Valve Spring (Intake) 303-452 (T93P-6565-AR)
	Compressor, Valve Spring (Exhaust) 303-567 (T97P-6565-AH)

 ST1693-A	
 ST1479-A	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
	Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

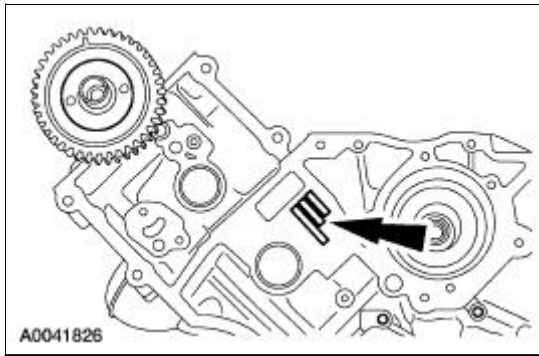
Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Canada CXC-10; in Oregon VC-5) or equivalent	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Canada VC-7-B) or equivalent	WSS-M97B51-A1

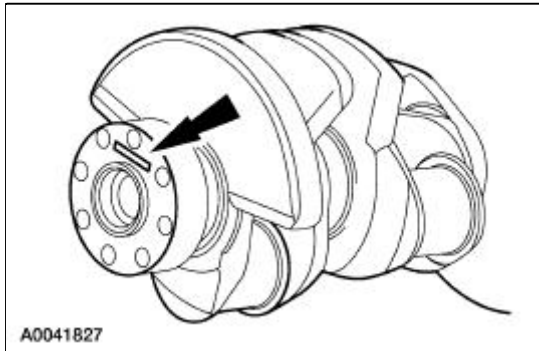
Assembly

NOTE: Before assembling the cylinder block, all sealing surfaces must be free from chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

1. Record the main bearing code found on the front of the engine block.



2. Record the main bearing code found on the back of the crankshaft.



3. Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings determine the required bearing grade for each main bearing.
 - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
 - Read down the column below the engine block main bearing code letter, and across the row next to the crankshaft main bearing code letter, until the two intersect. This is the required bearing grade for the number one crankshaft main bearing.
 - As an example, if the engine block code letter is "F" and the crankshaft code letter is "D", the correct bearing grade for this main bearing is a "2".
 - Repeat this process for the remaining four main bearings.

MAXIMUM CRANKSHAFT DIA

MINIMUM BLOCK DIA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	
	72.400	.401	.402	.403	.404	.405	.406	.407	.408	.409	.410	.411	.412	.413	.414	.415	.416	.417	.418	.419	.420	.421	.422	.423	.424
X	67.504	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
W	67.503	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
V	67.502	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
U	67.501	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
T	67.500	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
S	67.499	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
R	67.498	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Q	67.497	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
P	67.496	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
O	67.495	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
N	67.494	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
M	67.493	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
L	67.492	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
K	67.491	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
J	67.490	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
I	67.489	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
H	67.488	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3
G	67.487	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
F	67.486	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
E	67.485	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
D	67.484	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
C	67.483	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
B	67.482	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
A	67.481	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3

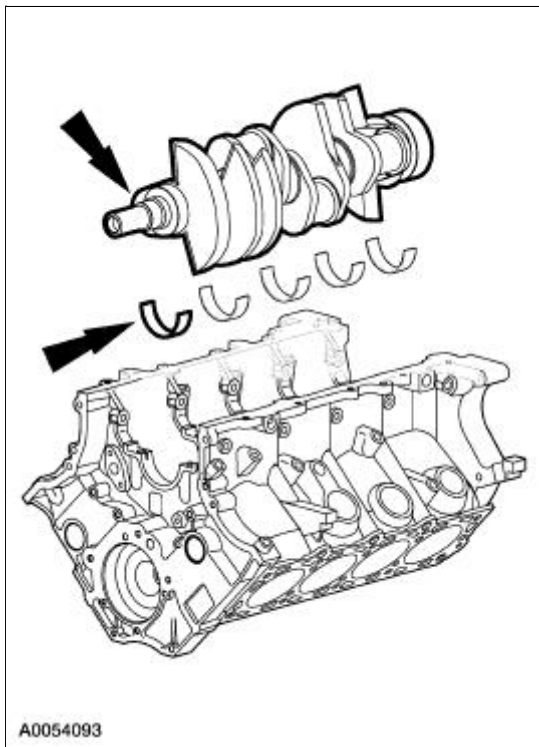
A0031544

- If oversize bearings are being used, use the procedure in the previous step and the Bearing Select Fit Chart, Oversize Bearings to determine the required bearing grade for each main bearing.

		MINIMUM BLOCK DIA																								
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	
		72.400	.401	.402	.403	.404	.405	.406	.407	.408	.409	.410	.411	.412	.413	.414	.415	.416	.417	.418	.419	.420	.421	.422	.423	.424
MAXIMUM CRANKSHAFT DIA	X 67.254	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
	W 67.253	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
	V 67.252	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
	U 67.251	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
	T 67.250	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
	S 67.249	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
	R 67.248	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
	Q 67.247	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
	P 67.246	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3
	O 67.245	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3
	N 67.244	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
	M 67.243	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
	L 67.242	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	K 67.241	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
	J 67.240	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
	I 67.239	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3
	H 67.238	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3
	G 67.237	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3
	F 67.236	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	E 67.235	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	D 67.234	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	C 67.233	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	B 67.232	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	A 67.231	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

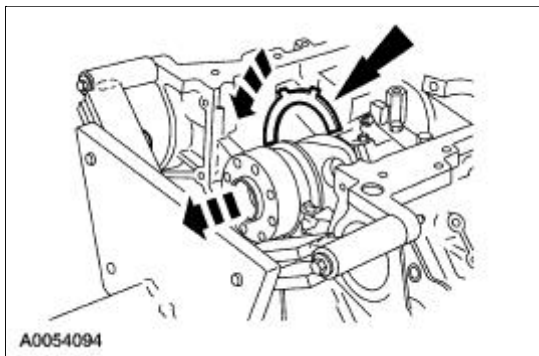
A0041840

- Install the crankshaft upper main bearings into the cylinder block and lubricate them with clean engine oil.
- Install the crankshaft onto the upper main bearings.



7. **NOTE:** The oil groove on the thrust washer must face toward the front of the engine (against the crankshaft thrust surface).

Install the thrust washer to the rear of the No. 5 upper main bearing.



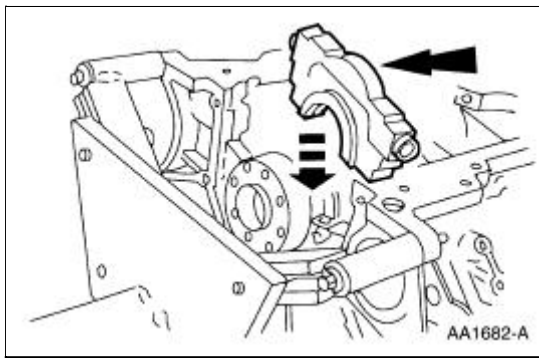
8. **NOTE:** Rotate the jack screws into the bearing caps enough to provide clearance to the cylinder block, prior to installing the bearing caps

NOTE: Install the thrust bearing to the rear main bearing cap and lubricate it with clean engine oil.

NOTE: Install the crankshaft lower main bearings into the main bearing caps and lubricate them with clean engine oil.

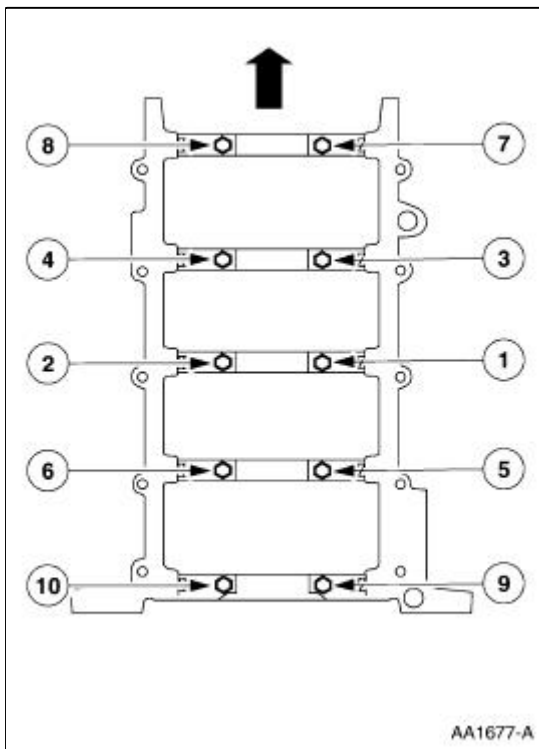
Apply forward force to the crankshaft, so that the crankshaft thrust face is against the No. 5 bulkhead. With the crankshaft in this position, locate the No. 5 main bearing cap on the cylinder block and tap into place using a plastic or dead blow hammer.

- Install the four remaining main bearing caps.



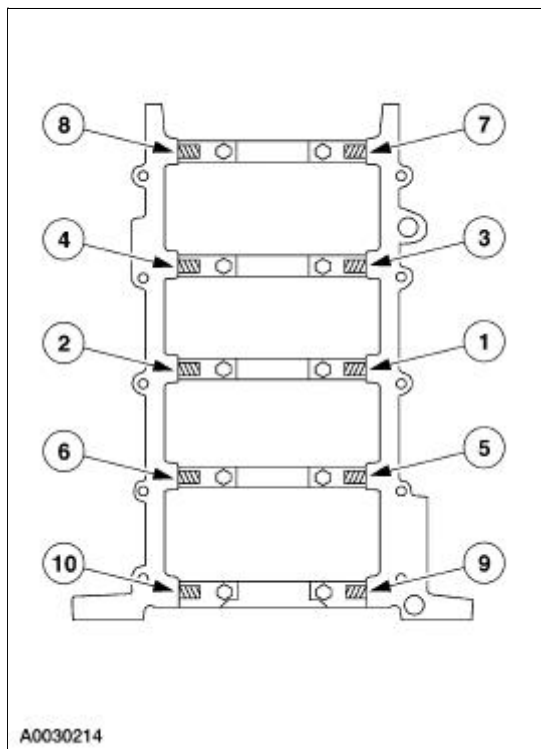
9. Install the vertical main bearing cap fasteners and tighten in the sequence shown, in two stages.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.

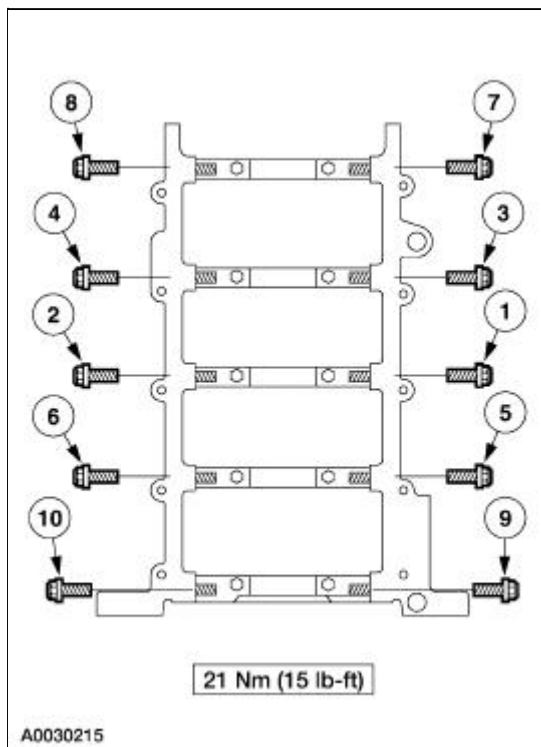


10. Tighten the jack screws against the cylinder block in the sequence shown, in two stages.

- Stage 1: Tighten to 5 Nm (44 lb-in).
- Stage 2: Tighten to 10 Nm (89 lb-in).



11. Install the side bolts and tighten them in the sequence shown.



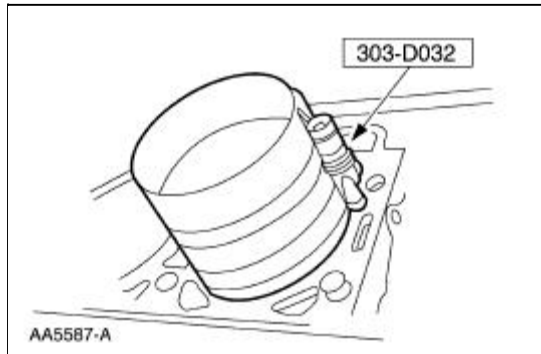
12. Check the crankshaft end play. For additional information, refer to [Section 303-00](#).

13.  **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

NOTE: Make sure that the piston arrow is facing forward.

NOTE: Lubricate the piston rings, cylinder walls and connecting rod bearings with clean engine oil.

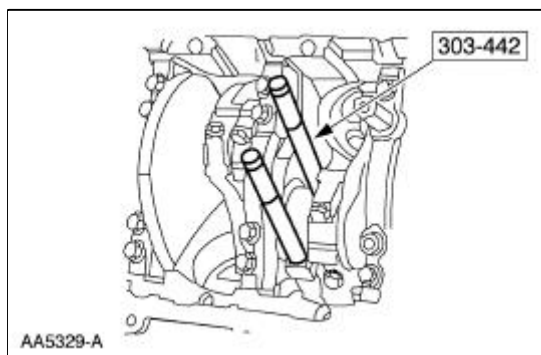
Using the special tool push the pistons through the top of the cylinder block.



14.  **CAUTION:** Do not scratch the cylinder walls or the crankshaft journals with the connecting rod.

NOTE: Make sure the crankshaft is at top dead center (TDC).

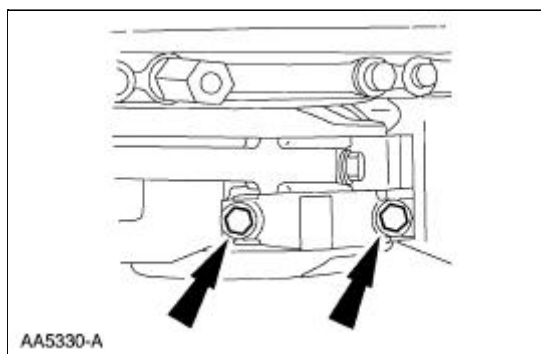
Using the special tool, install the connecting rod assemblies.



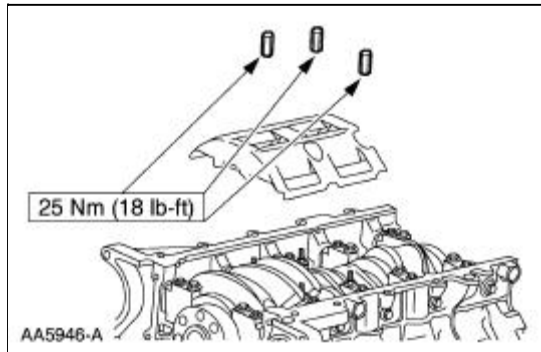
15. **NOTE:** The rod bearing cap bolts are torque-to-yield. Install new bolts, each time they are serviced.

Install the connecting rod bearing caps and bolts. and tighten in three stages.

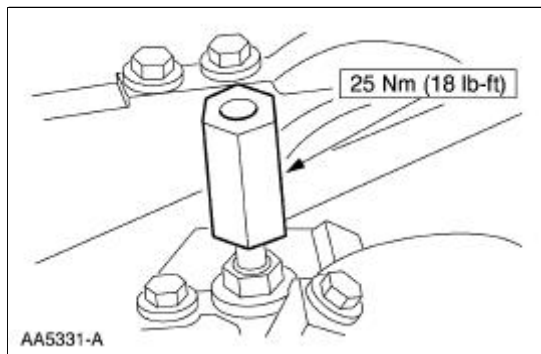
- Stage 1: Tighten to 25 Nm (18 lb-ft).
- Stage 2: Tighten to 45 Nm (33 lb-ft).
- Stage 3: Tighten an additional 90 degrees.



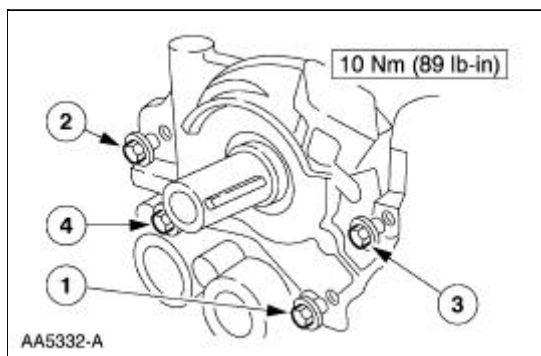
16. Check the connecting rod bearing clearance. For additional information, refer to [Section 303-00](#).
17. Install the windage tray.



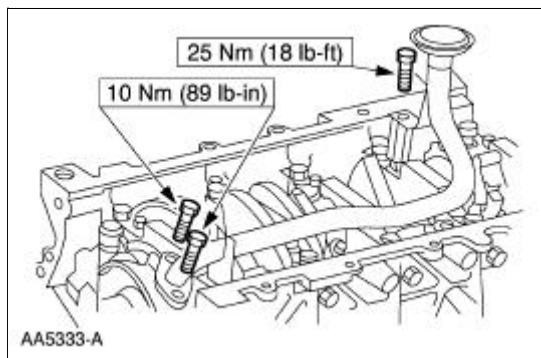
18. Install and tighten the oil pump screen spacer.



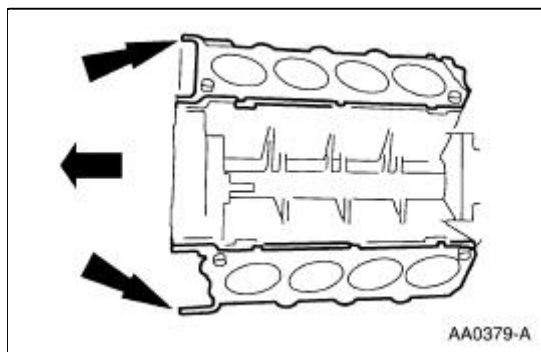
19. Position the oil pump; tighten the bolts in the sequence shown.



20. **NOTE:** Install a new O-ring if necessary.
- Install the oil pump screen cover and tube.



21. Install the cylinder head gaskets.



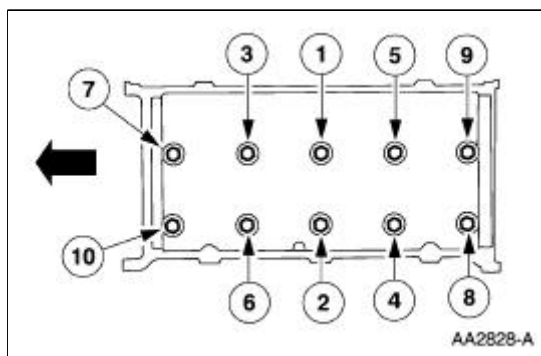
22. **NOTE:** Install new cylinder head bolts.

NOTE: LH is shown, RH is similar.

NOTE: Lubricate the bolt heads and threads. Use clean engine oil.

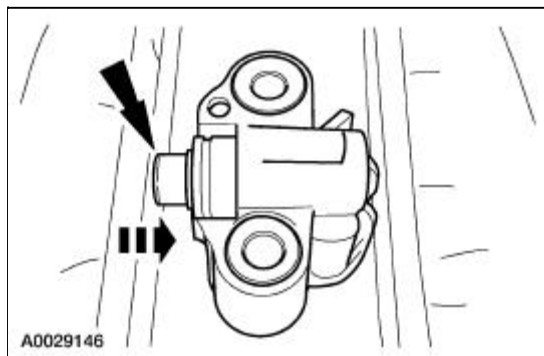
Install the LH and RH cylinder heads and tighten the bolts in six stages, in the sequence shown.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Tighten an additional 90 degrees.
- Stage 3: Loosen the bolts a minimum of one full turn.
- Stage 4: Tighten to 40 Nm (30 lb-ft).
- Stage 5: Tighten an additional 90 degrees.
- Stage 6: Tighten an additional 90 degrees.

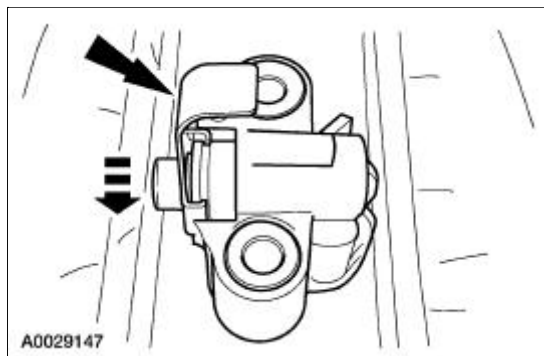


23.  **CAUTION:** Timing chain procedures must be followed exactly or damage to valves and pistons will result.

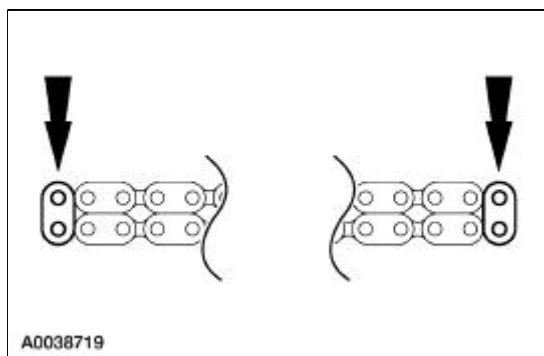
Compress the tensioner plunger, using a vise.



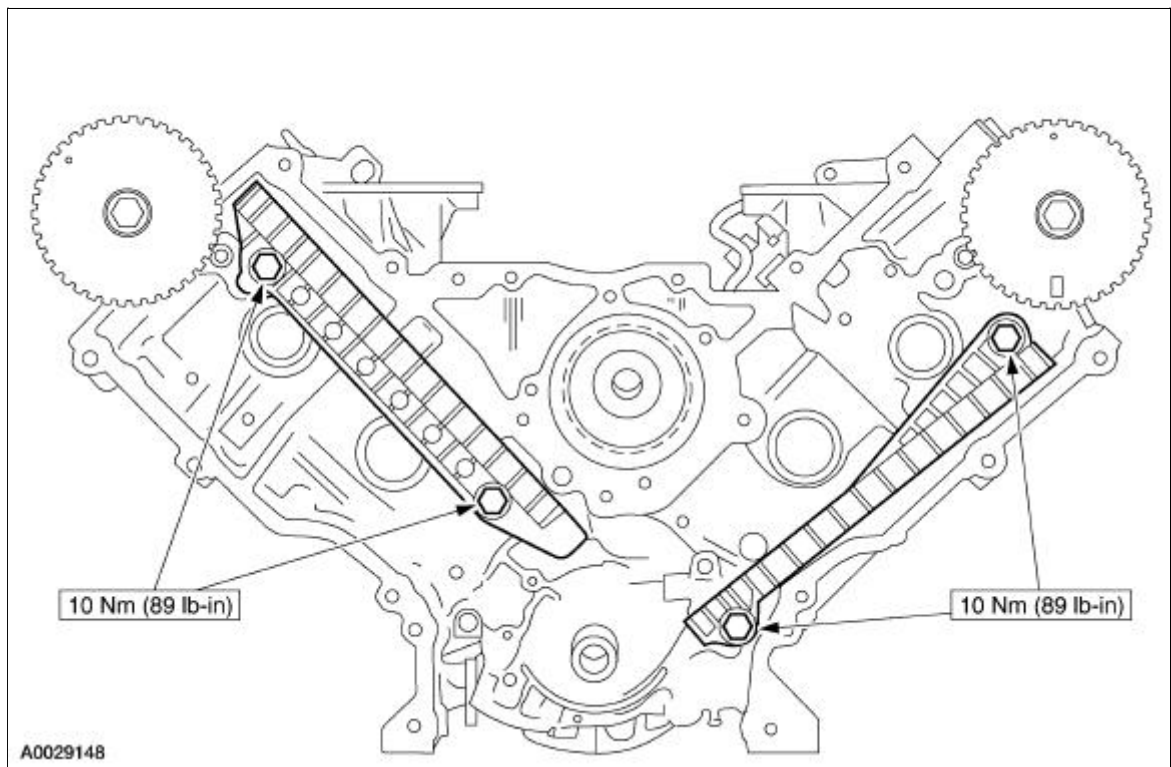
24. Install a retaining clip on the tensioner to hold the plunger in during installation.



25. Remove the tensioner from the vise.
26. If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.

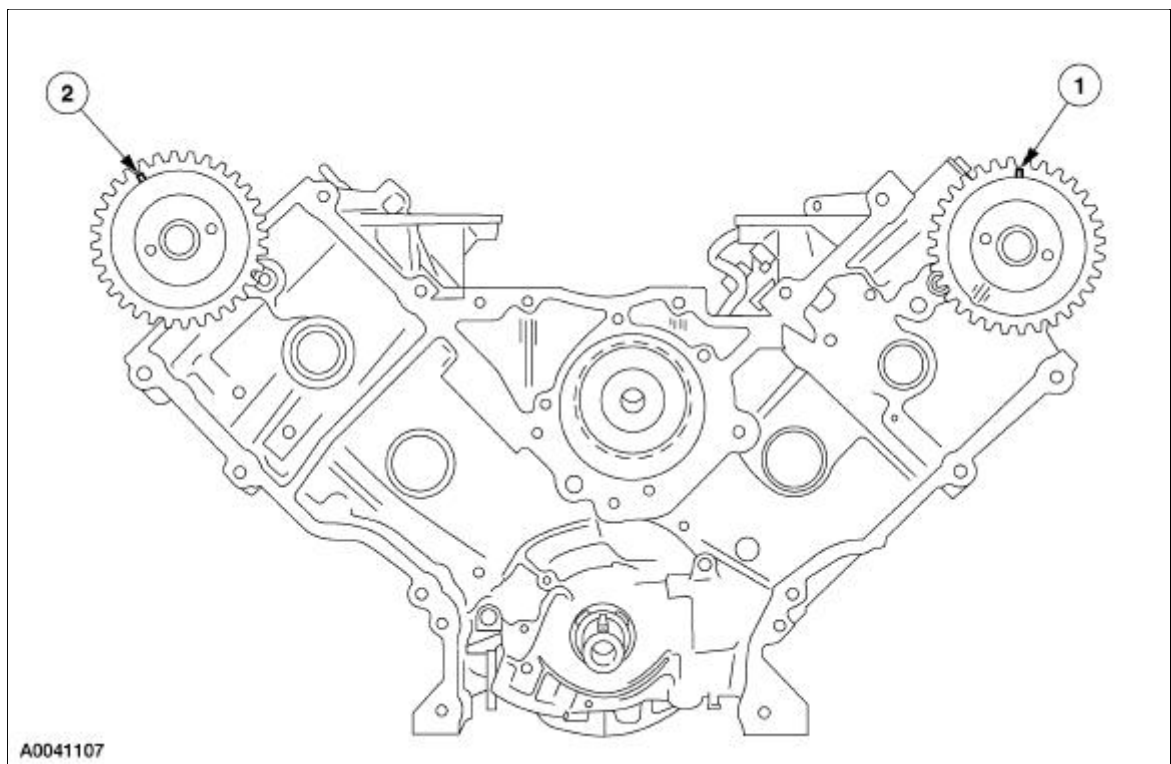


27. Install the timing chain guides.

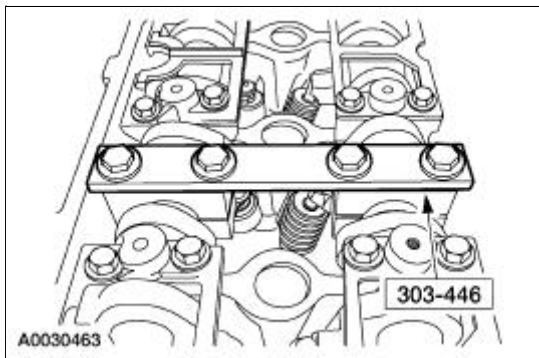


28. Pre-position the camshafts.

1. Rotate the LH camshaft until the timing mark is approximately at 12 o'clock.
2. Rotate the RH camshaft until the timing mark is approximately at 11 o'clock.



29. Install the special tool.

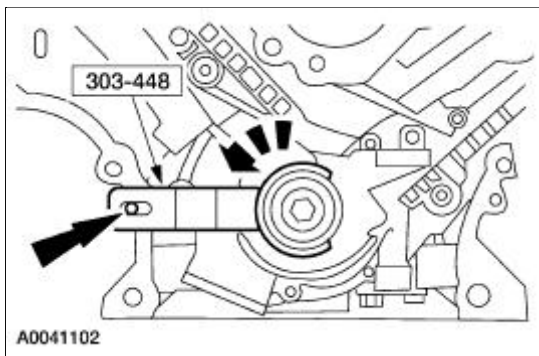


30. **CAUTION:** Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or camshaft to be rotated. Severe piston and valve damage will occur.

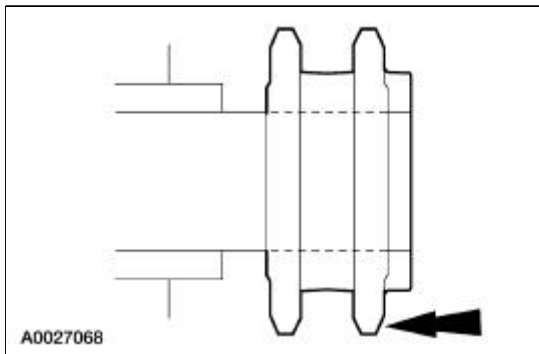
CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston and/or valve damage will occur.

Using the special tool, position the crankshaft.

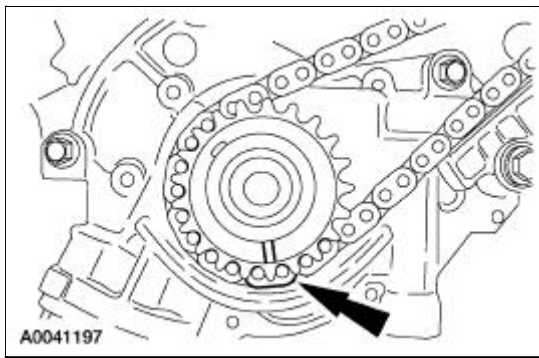
- Remove the special tool.



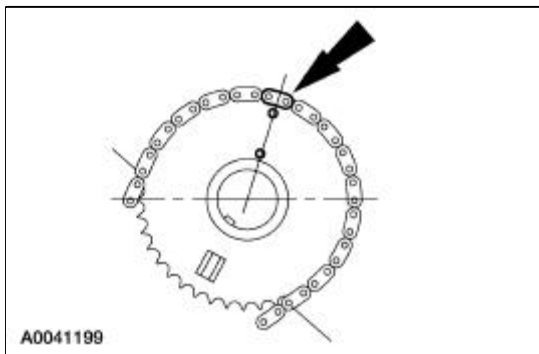
31. Install the crankshaft sprocket with the flange facing forward.



32. Position the LH (inner) timing chain onto the crankshaft sprocket, aligning the one copper link on the timing chain with the slot on the crankshaft sprocket.

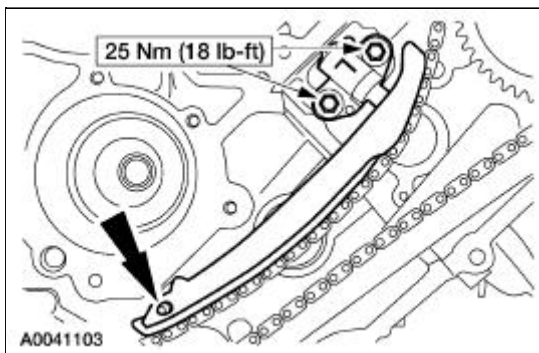


33. Install the LH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.

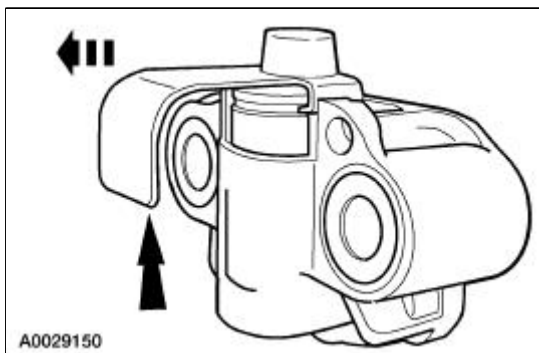


34. **NOTE:** The LH timing chain tensioner arm has a bump near the dowel hole for identification.

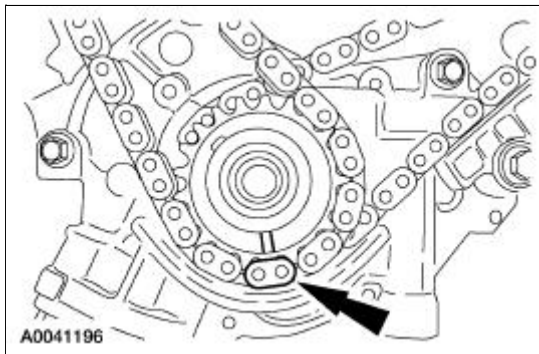
Position the LH timing chain tensioner arm on the dowel pin and install the LH timing chain tensioner.



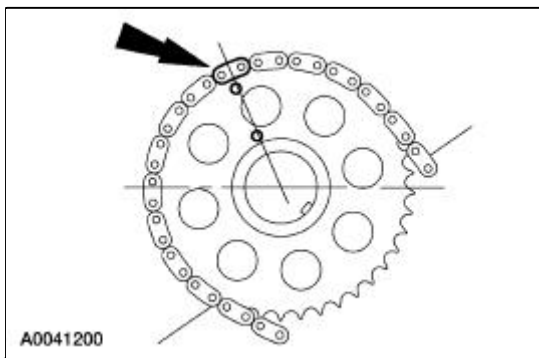
35. Remove the retaining clip from the LH timing chain tensioner.



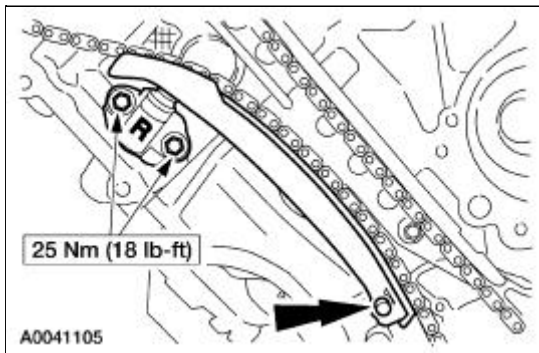
36. Position the RH (outer) timing chain on the crankshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.



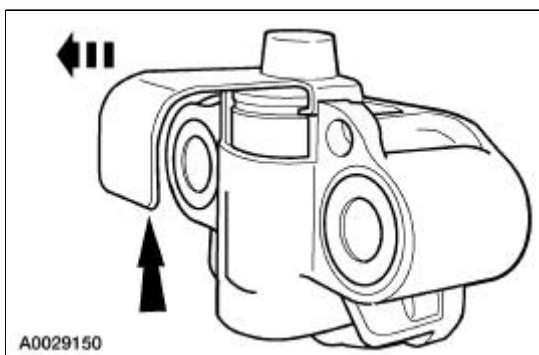
37. Install the RH timing chain on the camshaft sprocket, aligning the copper (marked) link with the timing marks on the sprocket.



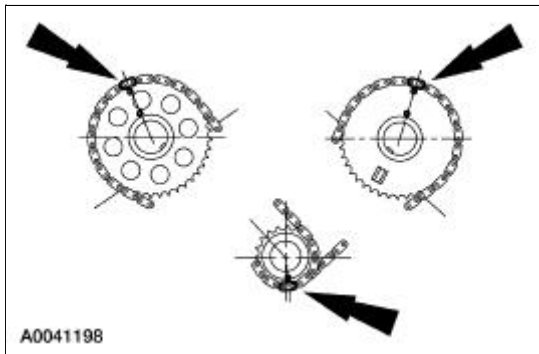
38. Position the RH timing chain tensioner arm on the dowel pin and install the RH timing chain tensioner.



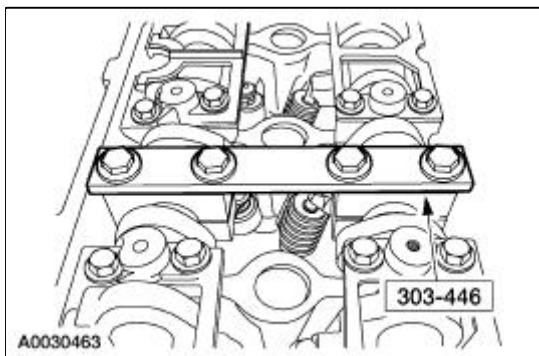
39. Remove the retaining clip from the RH timing chain tensioner.



40. As a post-check, make sure that the copper (marked) chain links are lined up with the dots on the crankshaft sprockets and the camshaft sprockets.

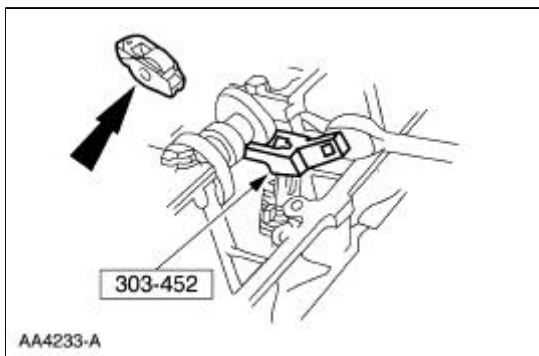


41. Remove the special tool.

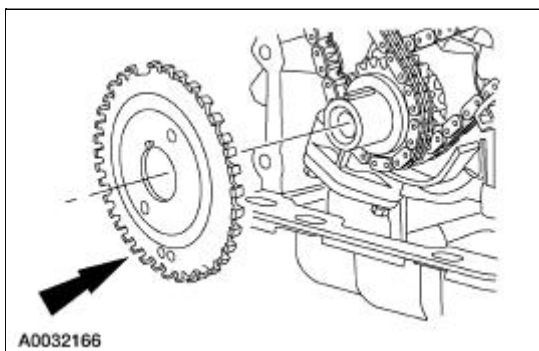


42. **NOTE:** Make sure the base circle of the camshaft is facing the roller follower being installed.

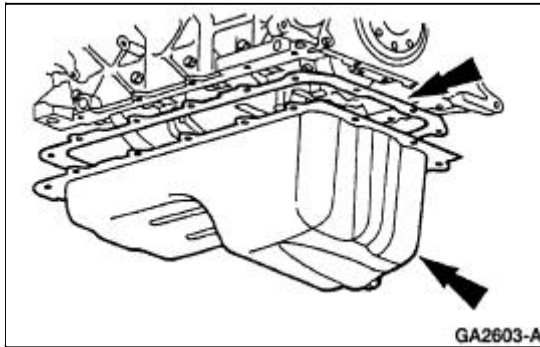
Using the special tool, install the 32 roller followers.



43. Position the crankshaft sensor ring on the crankshaft.

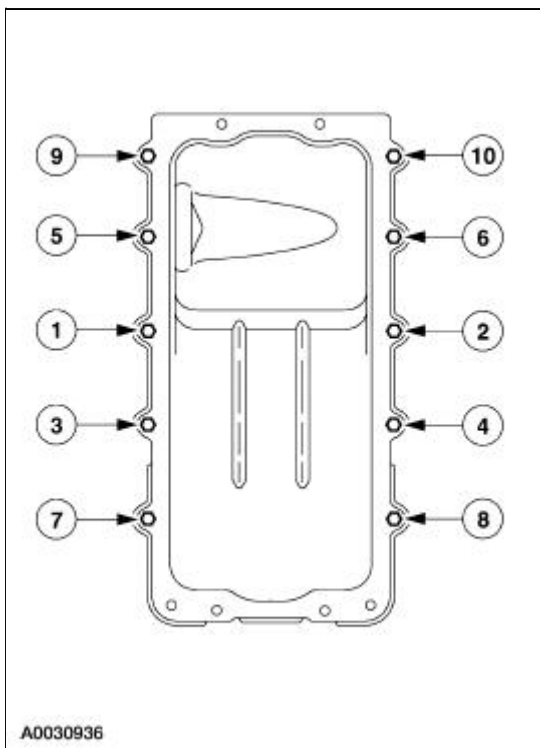


44. Install the oil pan and gasket, and loosely install the bolts.



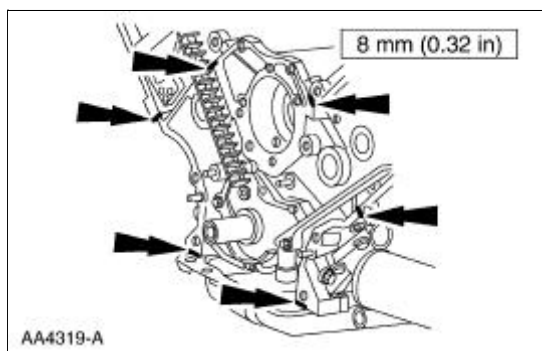
45. Tighten the bolts in the sequence shown, in two stages.

- Stage 1: Tighten to 20 Nm (15 lb-ft).
- Stage 2: Rotate an additional 60 degrees.

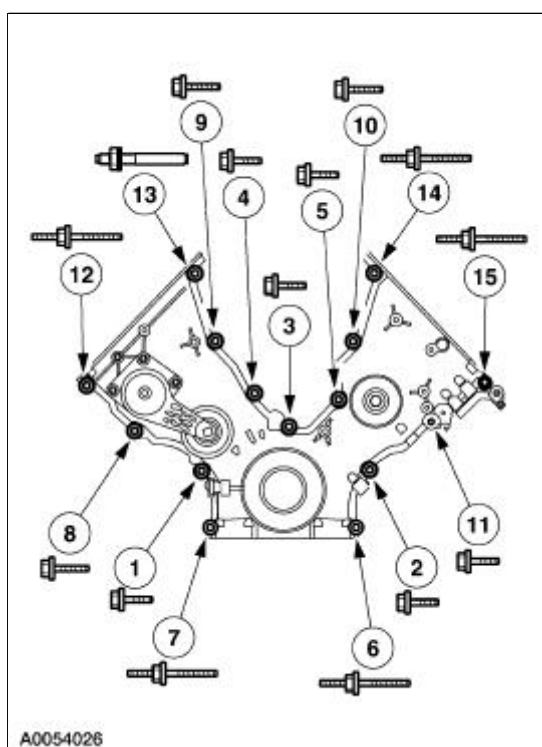


46. **NOTE:** If the engine front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant in the locations shown.



47. Install the engine front cover, the bolts and the studs, and tighten the fasteners in the sequence shown to 25 Nm (18 lb-ft).

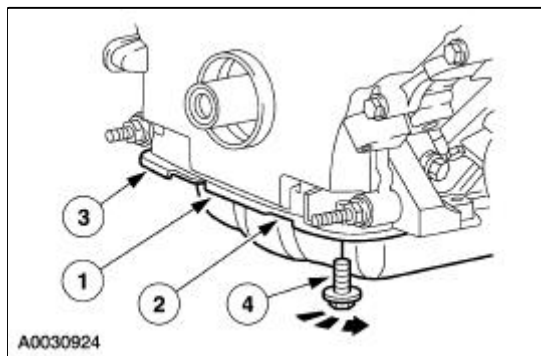


Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
7	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
12	W706560	Stud, Hex Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16

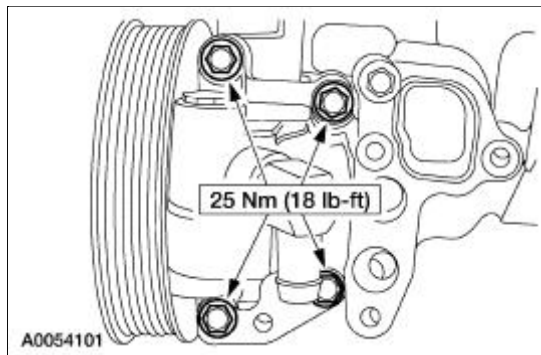
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 1.25 x 91.1

48. Tighten the four oil pan bolts in the sequence shown, in three stages.

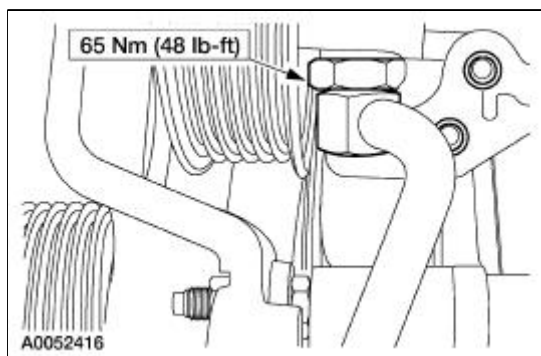
- Stage 1: Tighten to 2 Nm (18 lb-in).
- Stage 2: Tighten to 20 Nm (15 lb-ft).
- Stage 3: Tighten an additional 60 degrees.



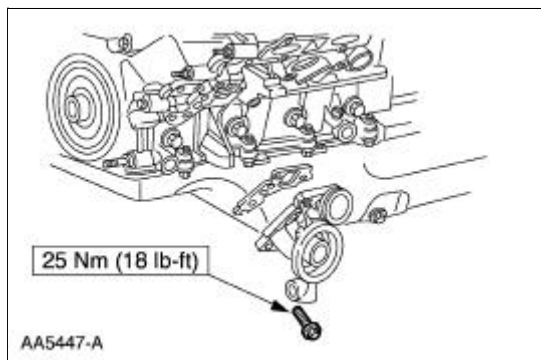
49. Install the power steering pump and the bolts.



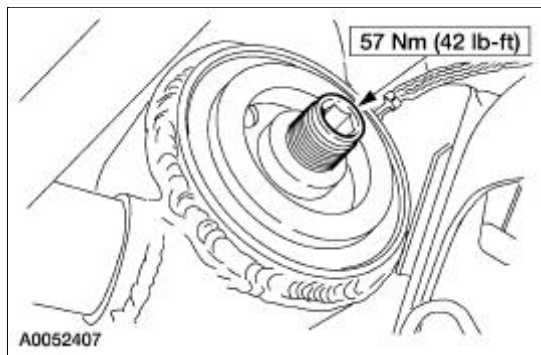
50. Install the power steering hose.



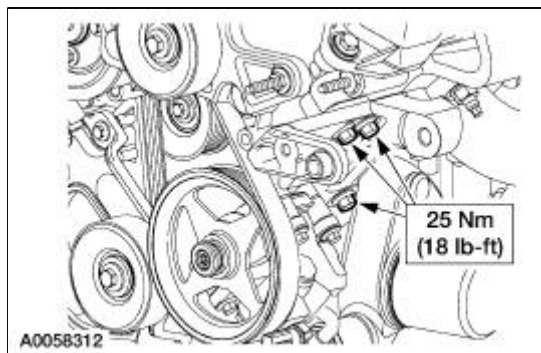
51. Install a new gasket and the oil filter adapter.



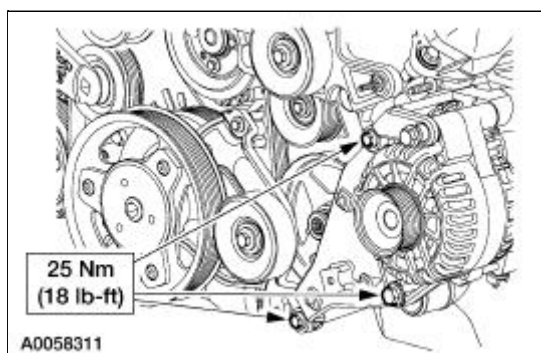
52. Install a new O-ring seal and the oil cooler.



53. Install the generator support bracket.



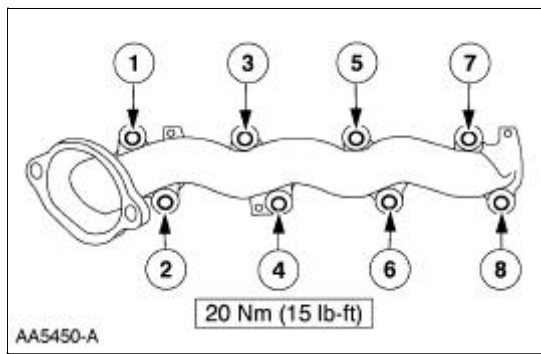
54. Install the generator.



55. **NOTE:** RH is shown, LH is similar. Use new gaskets when installing the exhaust manifolds.

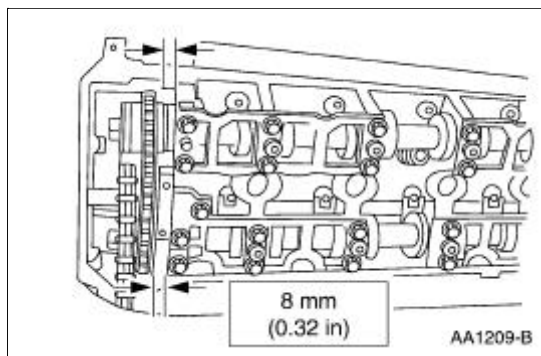
Install the exhaust manifolds.

- Tighten the nuts in the sequence shown.



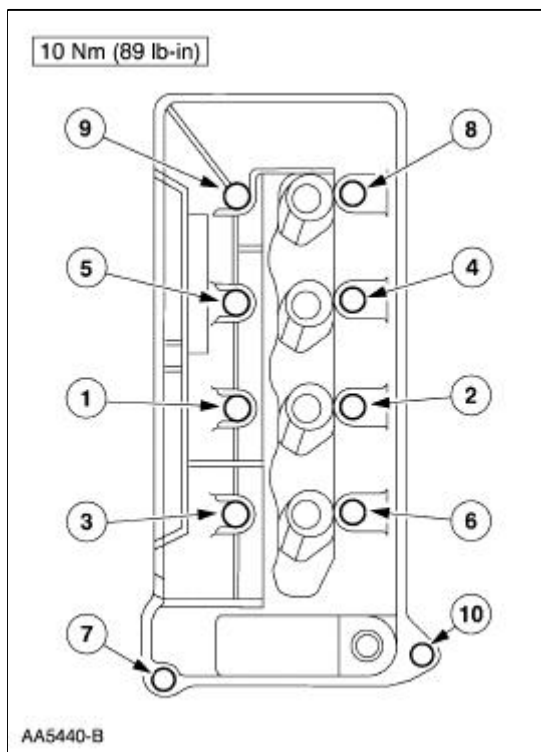
56. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant in the locations shown.

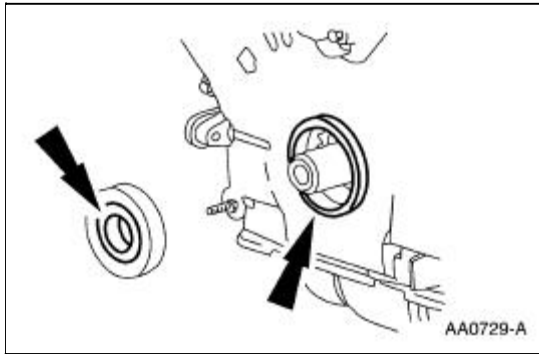


57. **NOTE:** RH is shown, LH is similar. Inspect and install new O-ring seals if necessary.

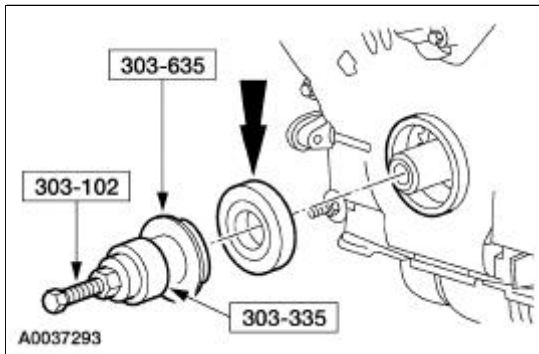
Install the valve covers and tighten the bolts in the sequence shown.



58. Lubricate the front oil seal and the engine front cover with clean engine oil.

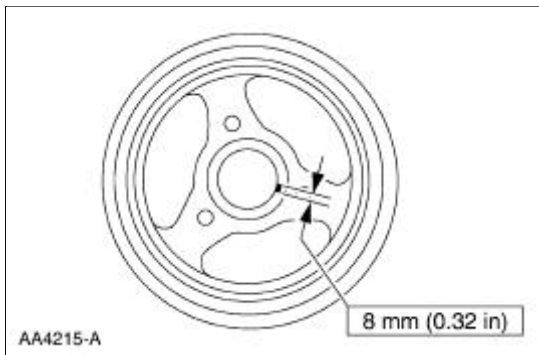


59. Using the special tools, install the front oil seal.

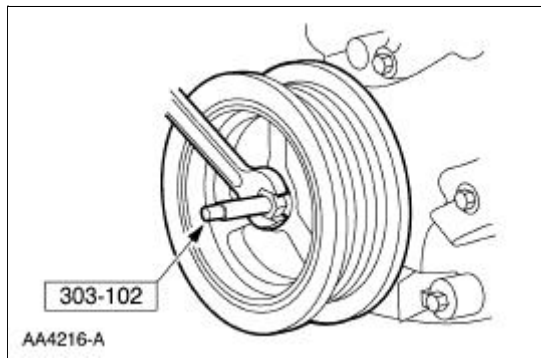


60. **NOTE:** If the crankshaft pulley is not installed within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply silicone gasket and sealant to the Woodruff key on the crankshaft pulley.

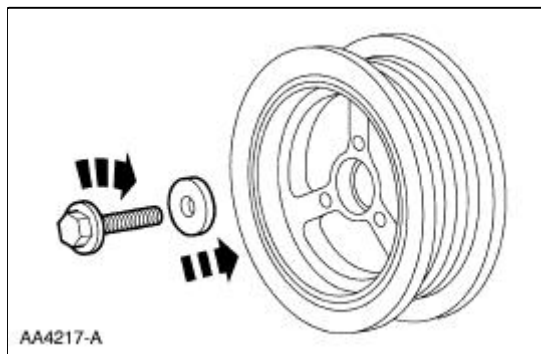


61. Using the special tool, install the crankshaft pulley.



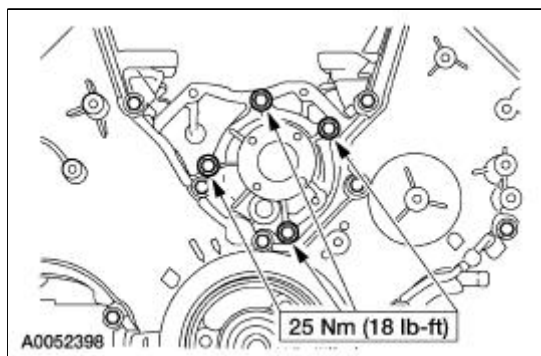
62. Install the crankshaft pulley and tighten the bolt in four stages.

- Stage 1: Tighten to 90 Nm (66 lb-ft).
- Stage 2: Loosen the bolt one full turn.
- Stage 3: Tighten to 50 Nm (37 lb-ft).
- Stage 4: Tighten an additional 90 degrees.

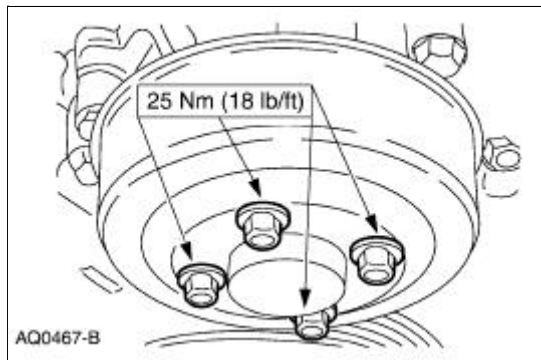


63. **NOTE:** Lubricate the O-ring seal with clean engine coolant.

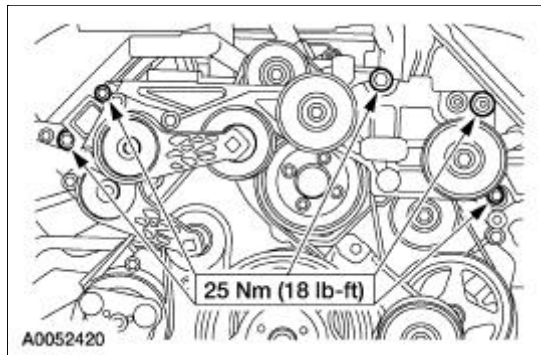
Install the water pump.



64. Install the water pump pulley and the bolts.



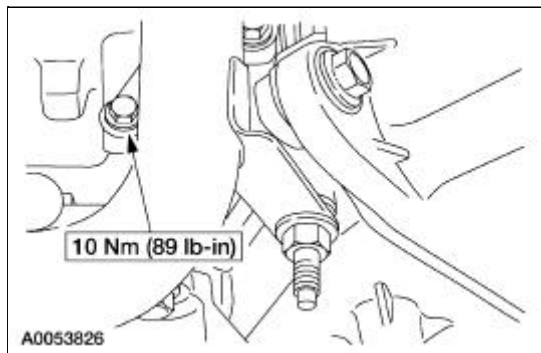
65. Install the supercharger belt idler support bracket assembly.



66. **NOTE:** Lubricate the O-rings with clean engine coolant.

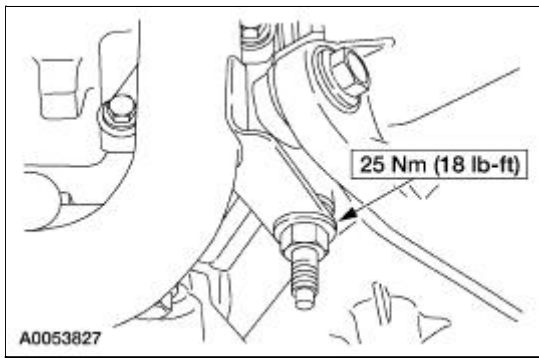
NOTE: LH is shown, RH is similar.

Install the coolant bypass tube and mounting bolts.



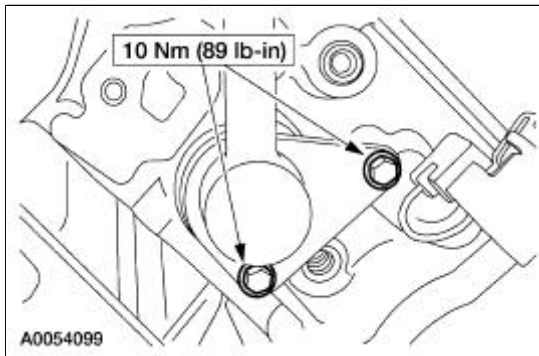
67. **NOTE:** LH is shown, RH is similar.

Install the coolant bypass tube studs.



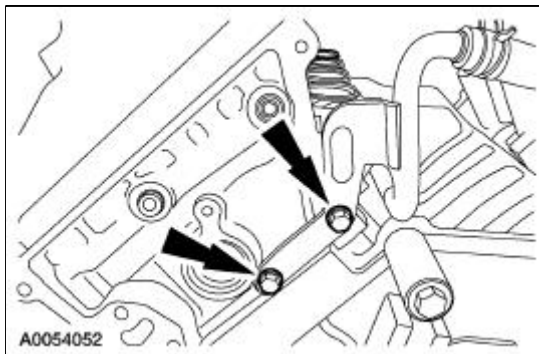
68. **NOTE:** Lubricate the O-ring with clean engine coolant.

Install the heater water inlet tube.



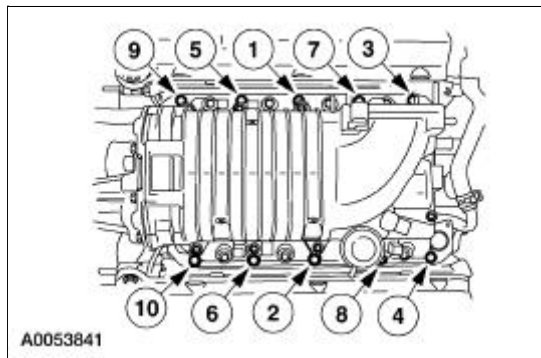
69. **NOTE:** Lubricate the O-rings with clean engine coolant.

Install the heater water outlet tube and the mounting bolts.

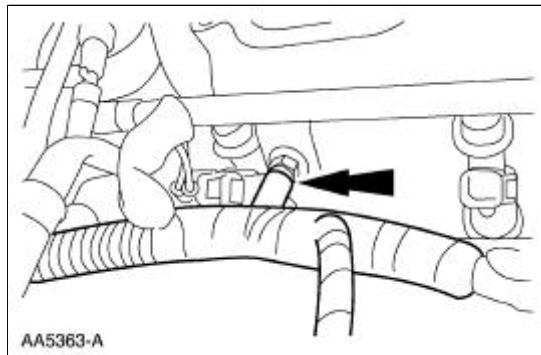


70. **NOTE:** Inspect the intake manifold gaskets and install new gaskets, if necessary.

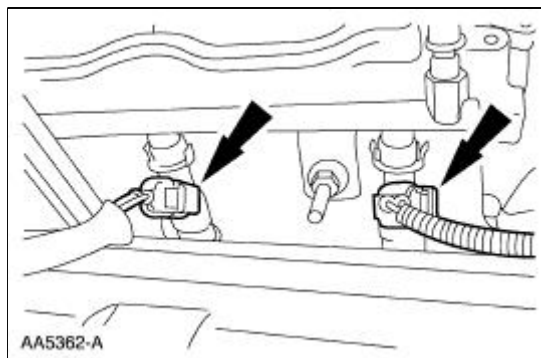
Install the intake manifold, supercharger and fuel supply manifold as an assembly, and tighten the bolts to 10 Nm (89 lb-in) in the sequence shown.



71. Position the wiring harness onto the engine and attach it to the four fuel supply manifold studs.

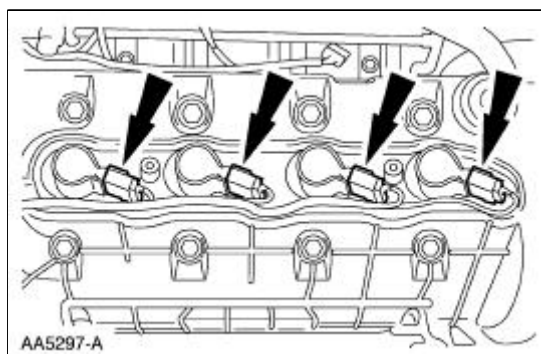


72. Connect the eight fuel injector electrical connectors.

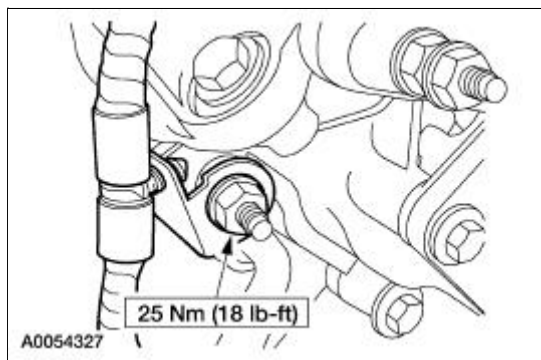


73. **NOTE:** RH is shown, LH is similar.

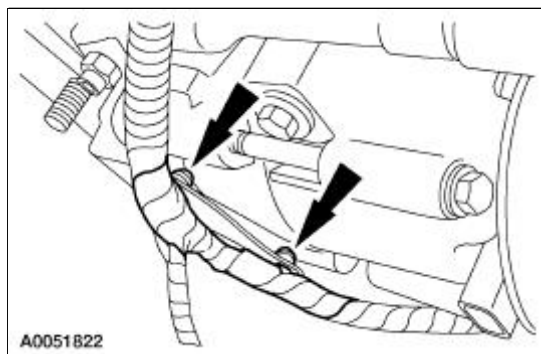
Install the RH and LH ignition coils and connect the electrical connectors.



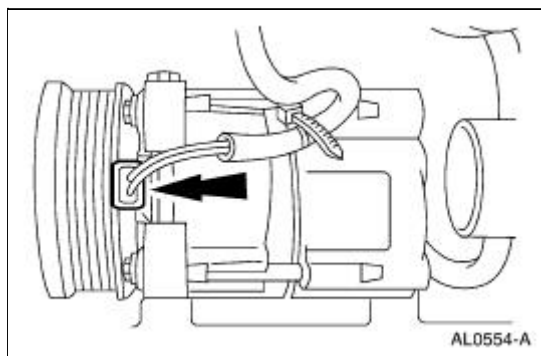
74. Install the harness support bracket.



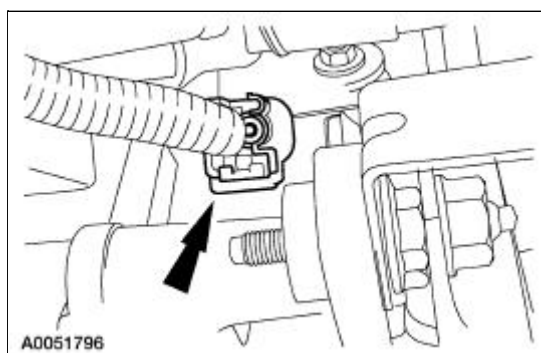
75. Clip the harness to the bracket.



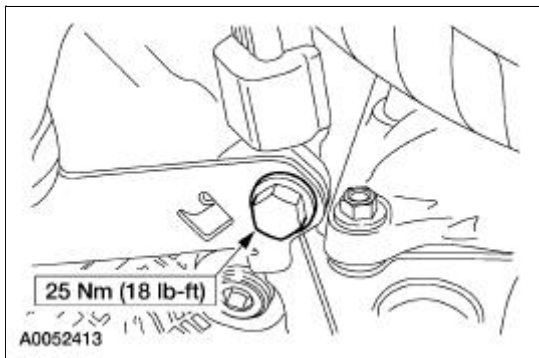
76. Connect the A/C compressor electrical connector.



77. Connect the crankshaft position (CKP) sensor electrical connector.

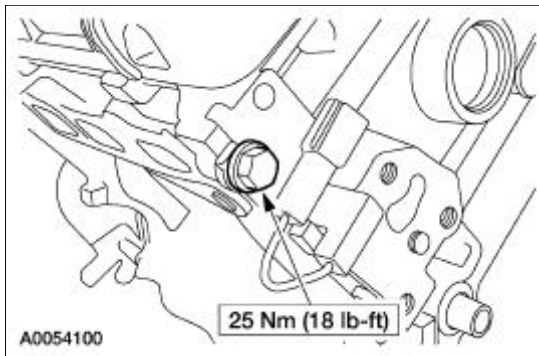


78. Install the fuel charging wiring harness bracket bolt.



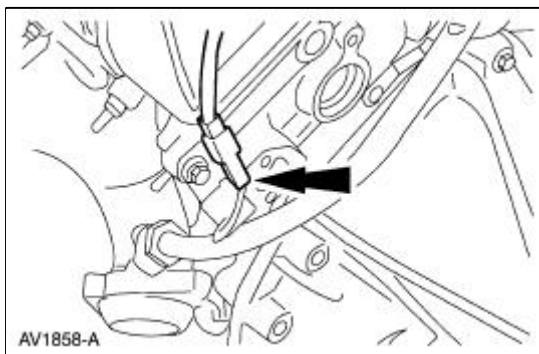
79. **NOTE:** LH is shown, RH is similar.

Install the RH and LH radio ignition interference capacitors.

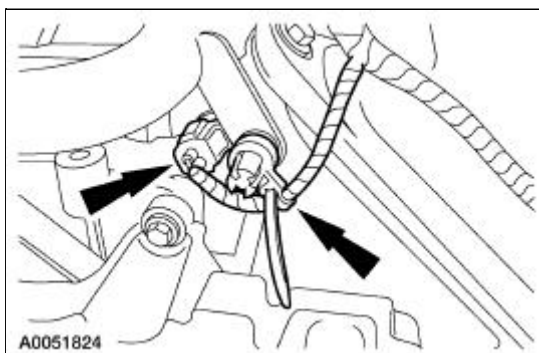


80. **NOTE:** LH is shown, RH is similar.

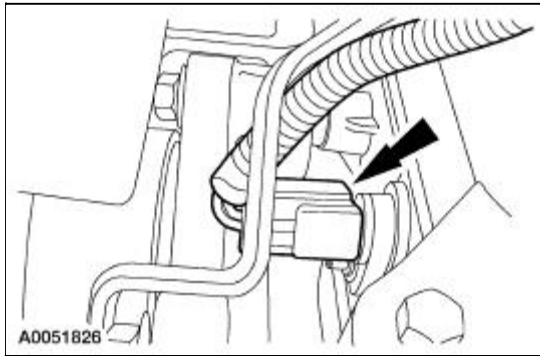
Connect the two radio ignition interference capacitor electrical connectors.



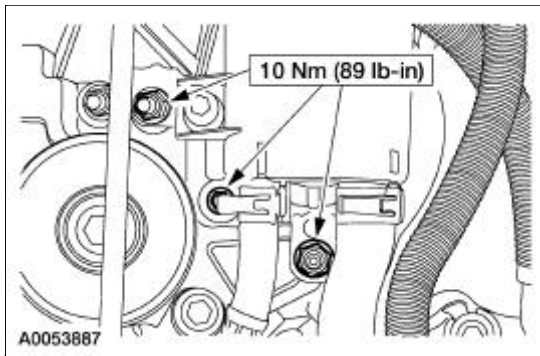
81. Connect the engine coolant temperature (ECT) sensor electrical connector, and attach the harness to the stud.



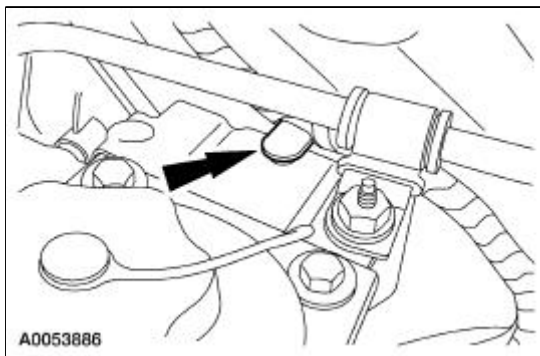
82. Connect the camshaft position (CMP) sensor electrical connector.



83. Install the power steering reservoir and mounting bolts.

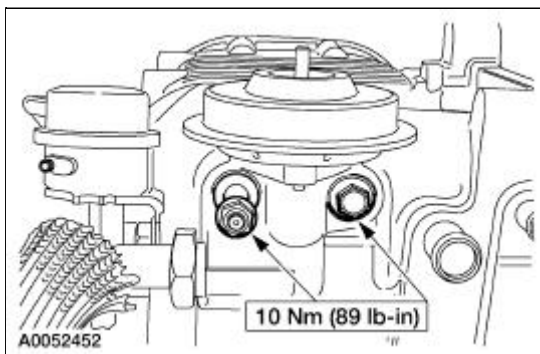


84. Attach the wiring harness to the power steering support bracket.

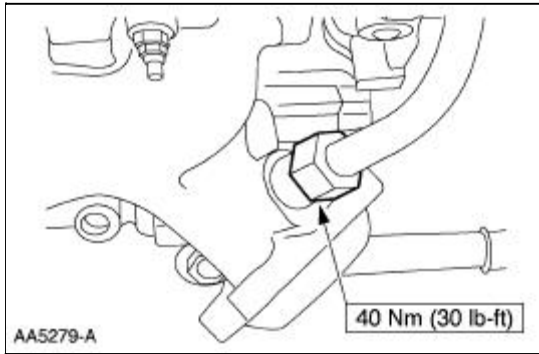


85. **NOTE:** Install a new exhaust gas recirculation (EGR) valve gasket.

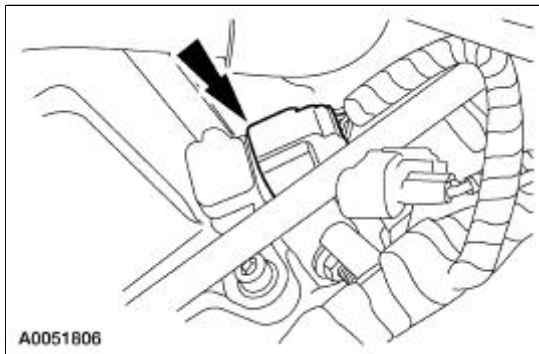
Install the EGR valve and tube as an assembly.



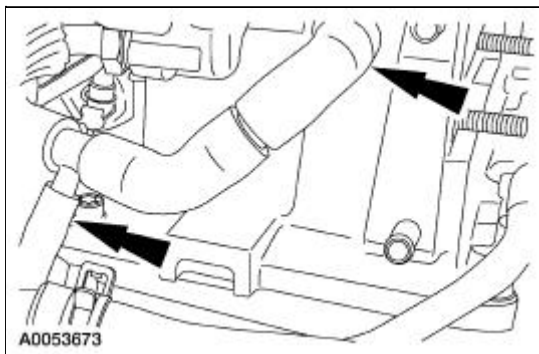
86. Tighten the EGR tube to the exhaust manifold.



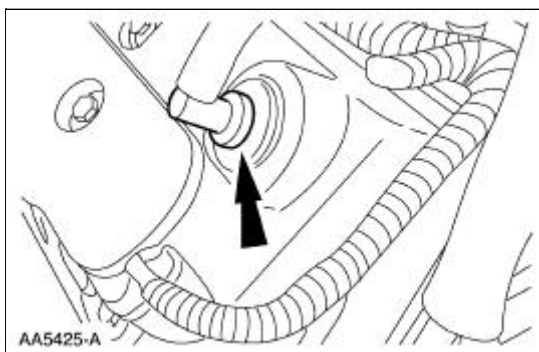
87. Connect the barometric pressure (BARO) sensor electrical connector.



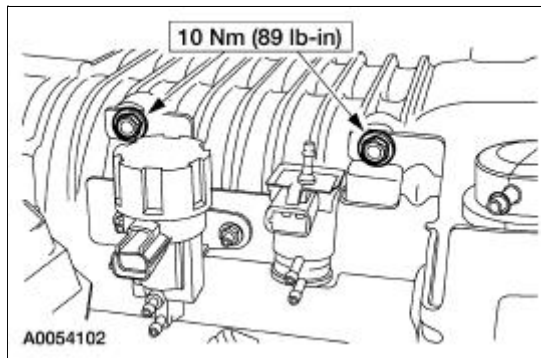
88. Install and connect the positive crankcase ventilation (PCV) hose.



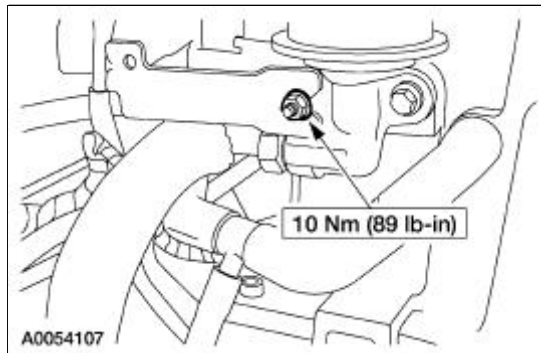
89. Install the PCV valve.



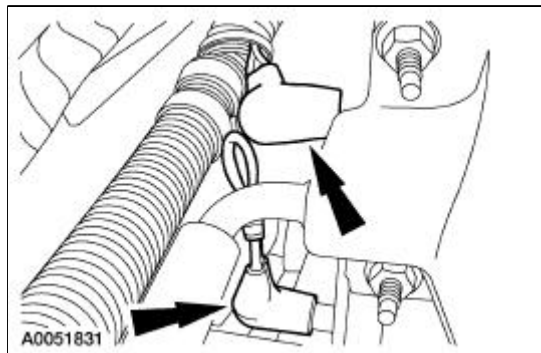
90. Install the vacuum accessory bracket and the mounting bolts.



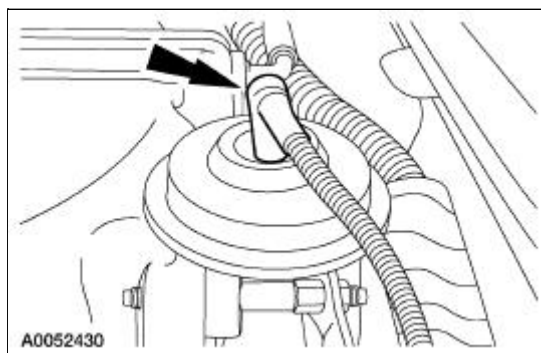
91. Install the vacuum accessory bracket mounting nut.



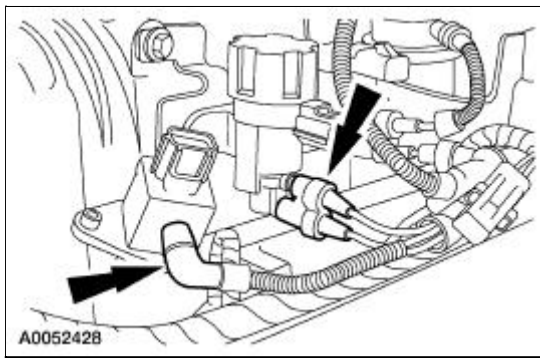
92. Position the vacuum harness and connect the vacuum hoses to the back of the supercharger.



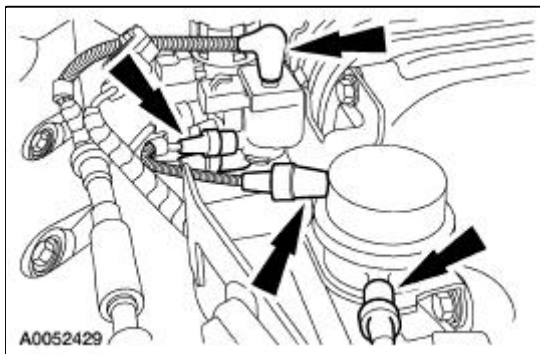
93. Connect the vacuum hose to the EGR valve.



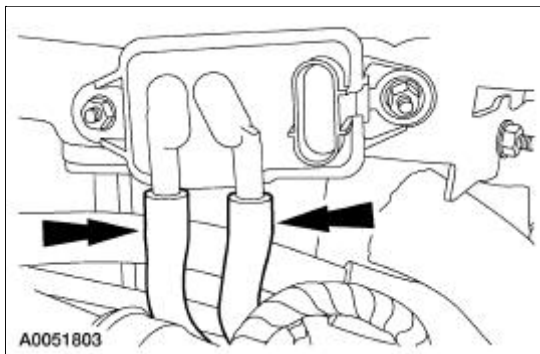
94. Connect the vacuum hoses to the fuel pulse damper and the EGR vacuum regulator solenoid.



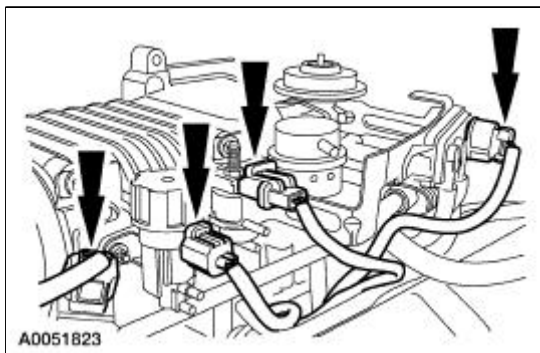
95. Connect the vacuum hoses to the supercharger bypass vacuum solenoid and the actuator.



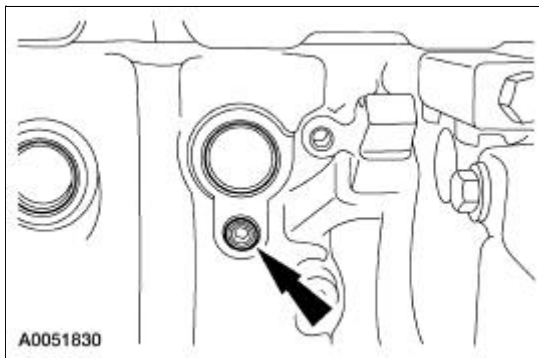
96. Connect the vacuum hoses to the differential pressure feedback EGR system.



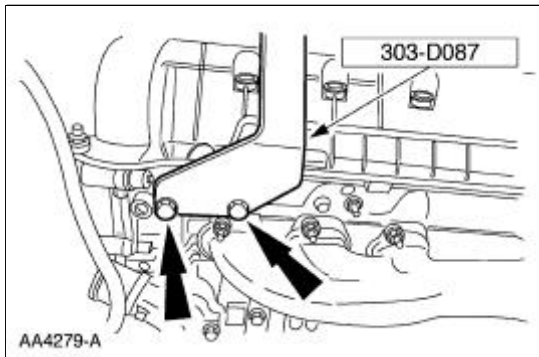
97. Connect the electrical connectors to the fuel pulse damper, EGR vacuum regulator solenoid, supercharger bypass vacuum solenoid, and the differential pressure feedback EGR system.



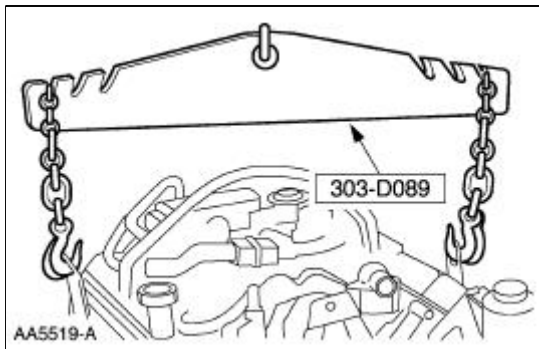
98. Install the drain plug.



99. Install the special tools.

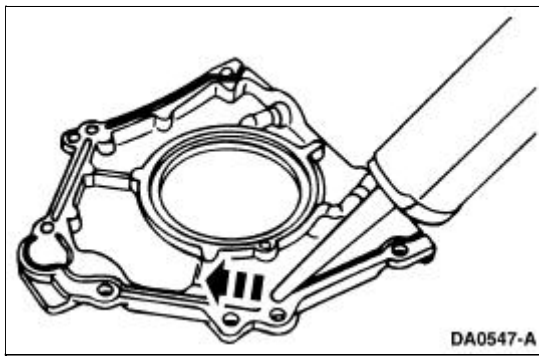


100. Attach the special tool to a floor crane and the engine, and remove the engine from the stand.



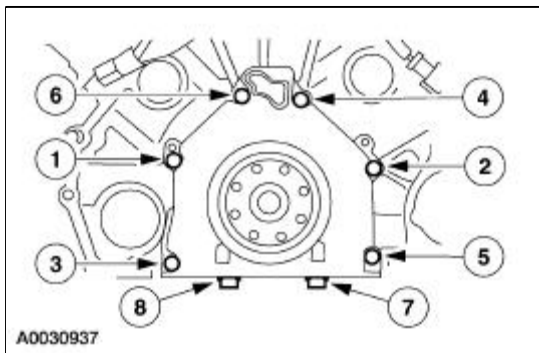
101. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing surface must be cleaned with metal surface cleaner. Allow the surface to dry until there is no sign of wetness or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

Apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the rear oil seal retainer plate sealing surface. Also apply a bead of silicone gasket and sealant at the junction where the cylinder block, oil pan and rear oil seal retainer plate meet.

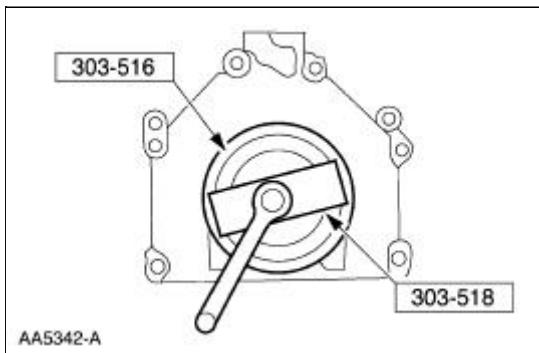


102. Install the rear oil seal retainer plate and tighten the bolts in the sequence shown.

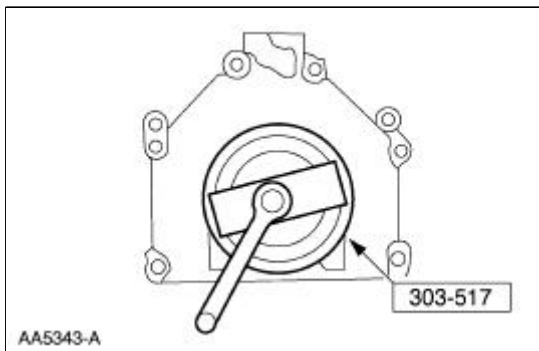
- Tighten bolts No. 1-6 to 10 Nm (89 lb-in).
- Tighten bolts No. 7 and 8 to 20 Nm (15 lb-ft)
- Tighten bolts No. 7 and 8 an additional 60 degrees.



103. Using the special tools, install the crankshaft rear main seal.

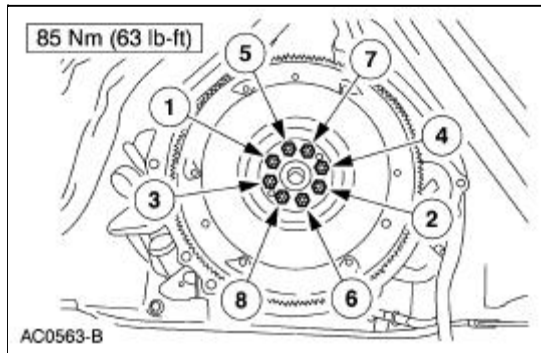


104. Using the special tool, install the crankshaft oil slinger.



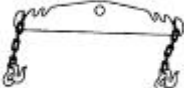
105. Install the flywheel and the bolts.

- Tighten the bolts in the sequence shown.



Engine

Special Tool(s)

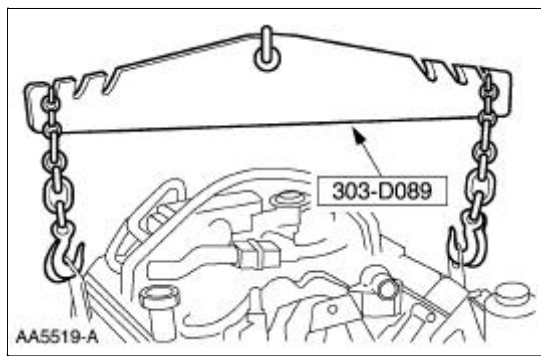
 ST1603-A	Lifting Bracket, Engine 303-D087 (D93P-6001-A1)
 ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

Material

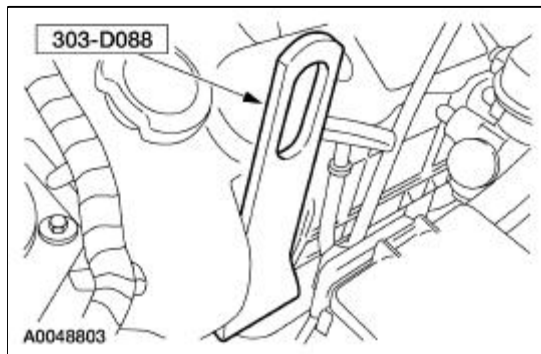
Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Canada CXC-10; in Oregon VC-5) or equivalent	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) or equivalent	WSS-M97B51-A1
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (MC YN-12-C)	WSH-M1C231-B

Installation

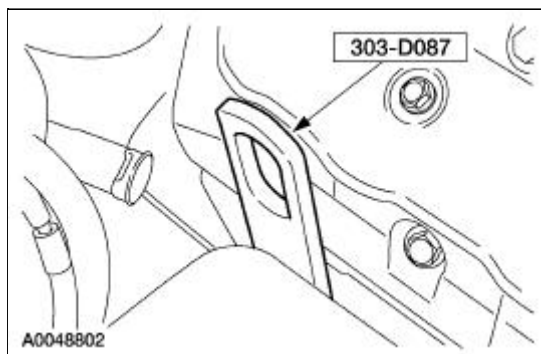
1. Install the engine in the vehicle and remove the floor crane and the special tool.



2. Remove the special tool.

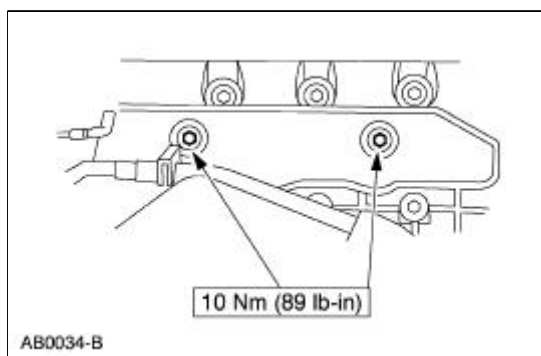


3. Remove the special tool.

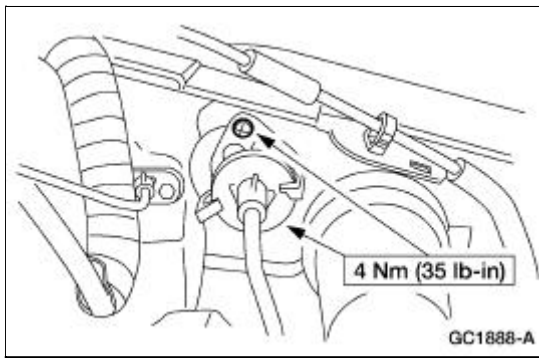


4. **NOTE:** RH is shown, LH is similar.

Install the RH and LH ignition coil covers.



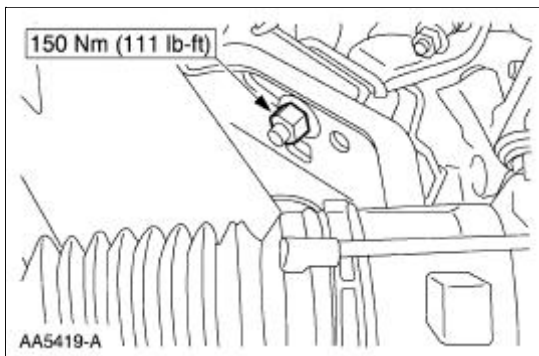
5. Install the clutch cable and retaining screws.



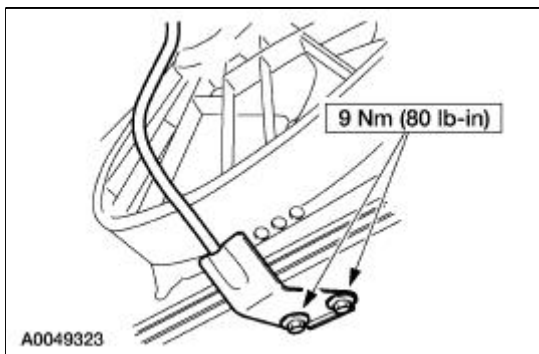
6. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

7. **NOTE:** RH is shown, LH is similar.

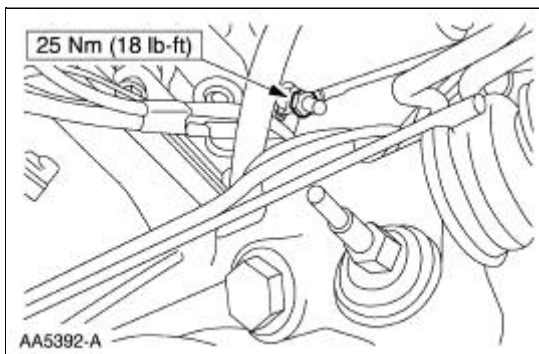
Install the two engine mount nuts.



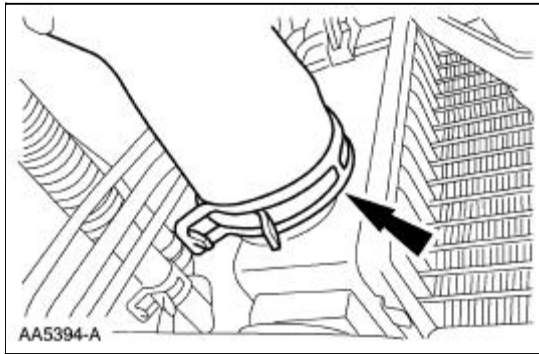
8. Install the degas bottle support bracket and the bolts.



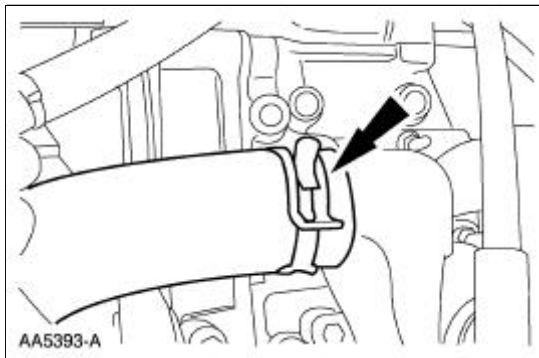
9. Install the ground strap and the bolt.



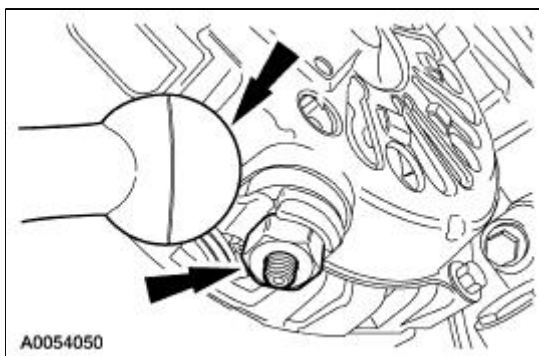
10. Connect the lower radiator hose.



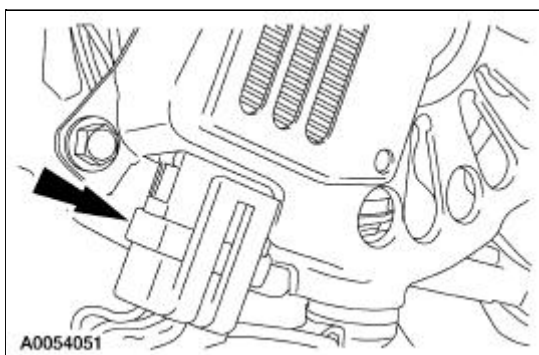
11. Connect the hose to the oil filter adapter.



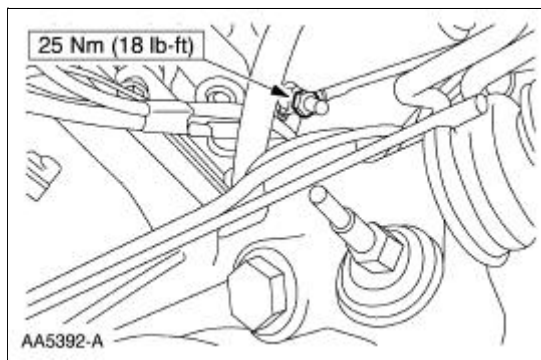
12. Attach the B + terminal cable and install the nut.



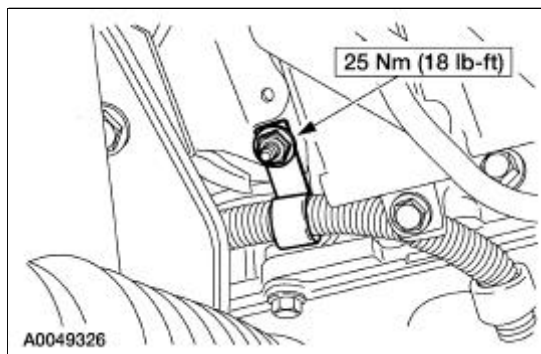
13. Connect the generator electrical connector.



14. Install the ground cable and the nut.

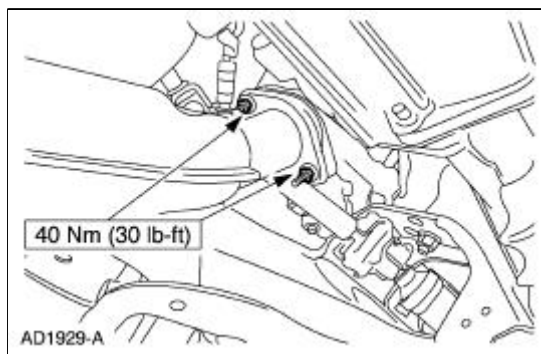


15. Position the wiring harness bracket and install the nut.

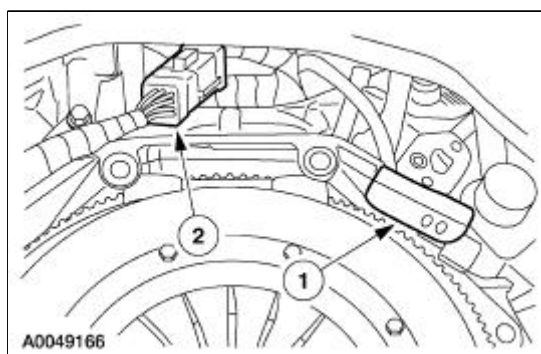


16. **NOTE:** RH is shown, LH is similar.

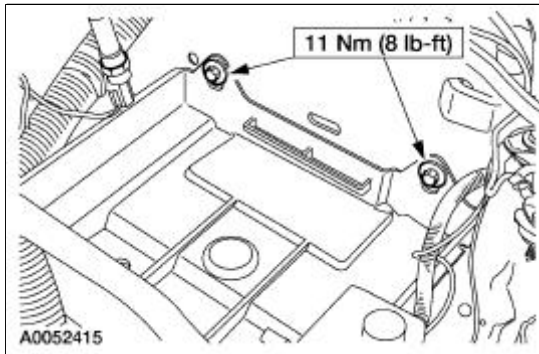
Position the exhaust and install the manifold flange nuts.



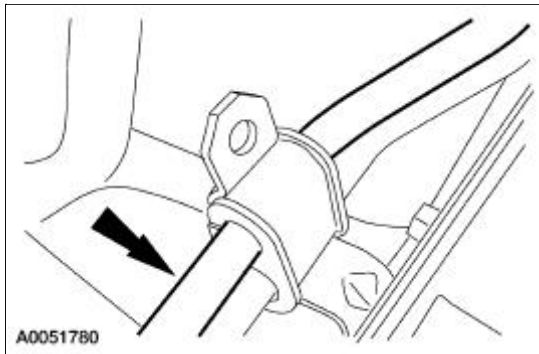
17. Connect the transmission wiring harness.
 1. Connect the RH oxygen sensor connector retainer.
 2. Connect the transmission harness electrical connector.



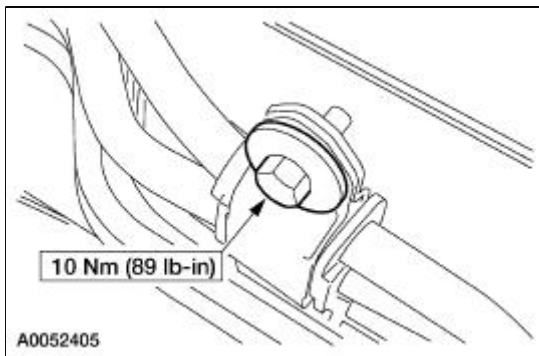
18. Install the clutch. For additional information, refer to [Section 308-01](#).
19. Install the auxiliary crankshaft pulley. For additional information, refer to [Crankshaft Pulley—Auxiliary](#) in this section.
20. Install the battery tray and the mounting bolts.



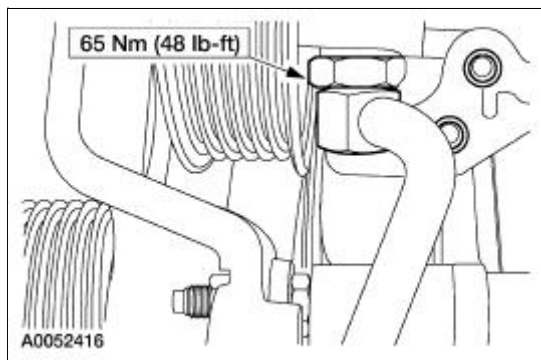
21. Position the power steering hose into the grommet.



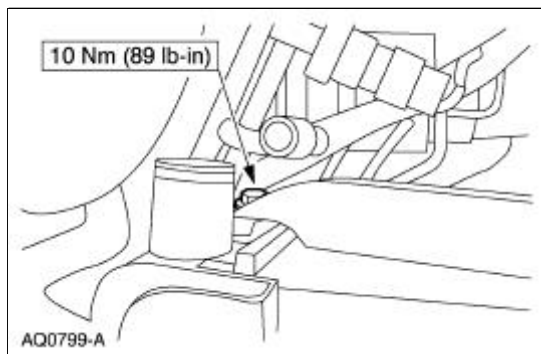
22. Install the bracket mounting bolt.



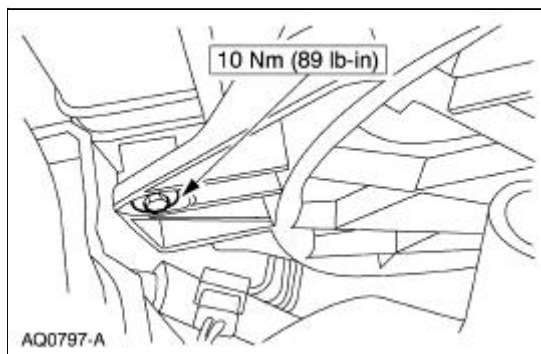
23. Position the power steering hose and tighten the fitting.



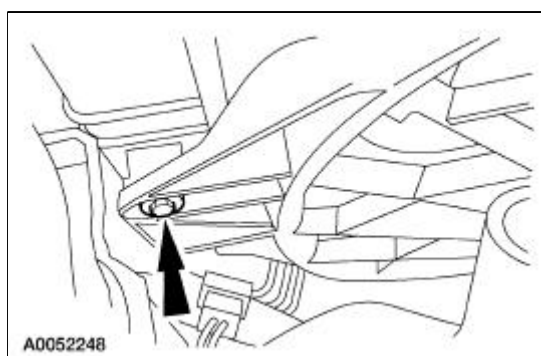
24. Install the cooling fan, motor and shroud as an assembly, and install the RH mounting bolt.



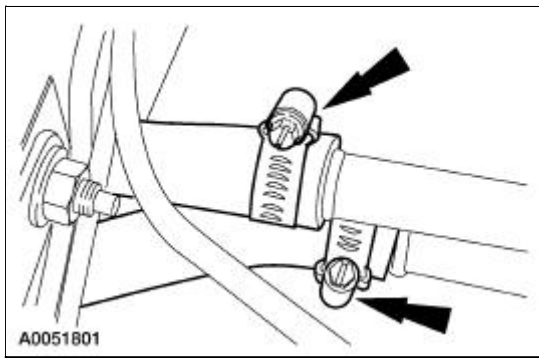
25. Install the LH cooling fan mounting bolt.



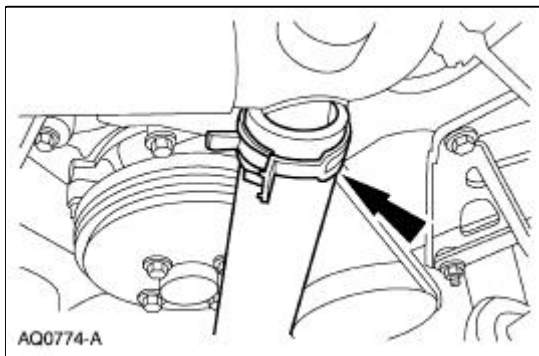
26. Connect the cooling fan electrical connector.



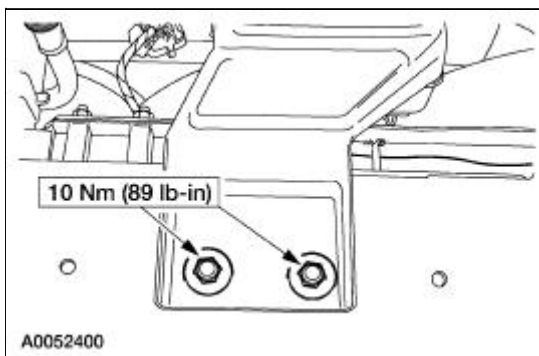
27. Install the supercharger cooling hose assembly and tighten the clamps.



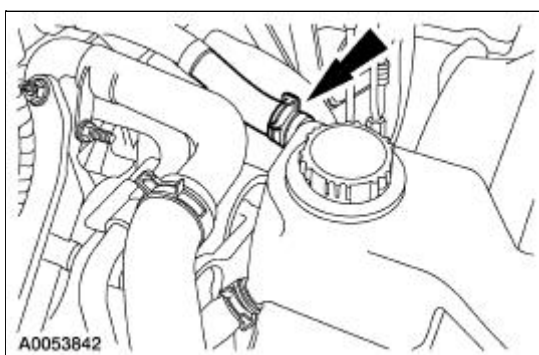
28. Connect the lower radiator hose to the coolant bypass tube.



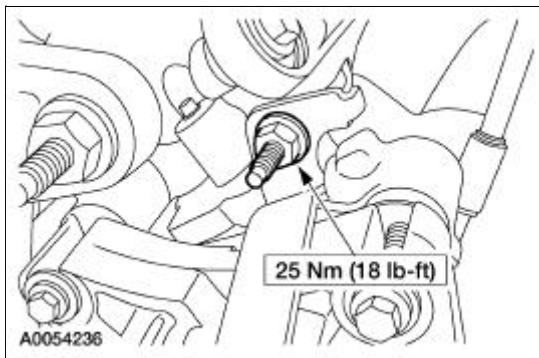
29. Install the supercharger degas bottle and the mounting bolts.



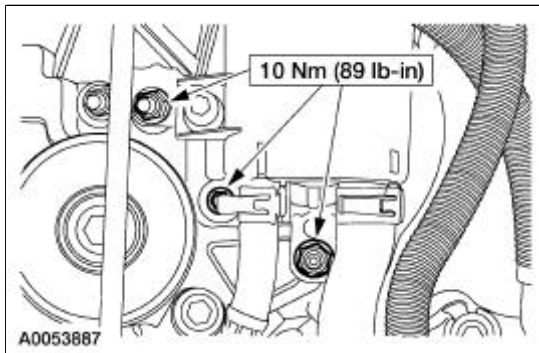
30. Connect the supercharger degas hose.



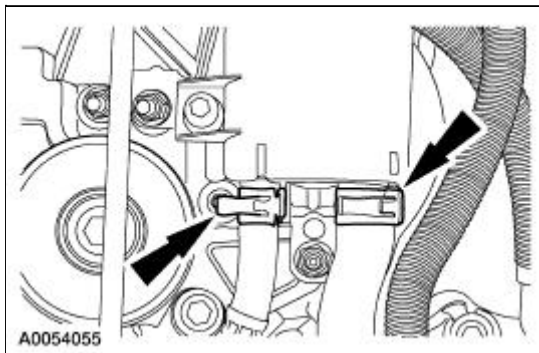
31. Install the power steering hose bracket and mounting nut.



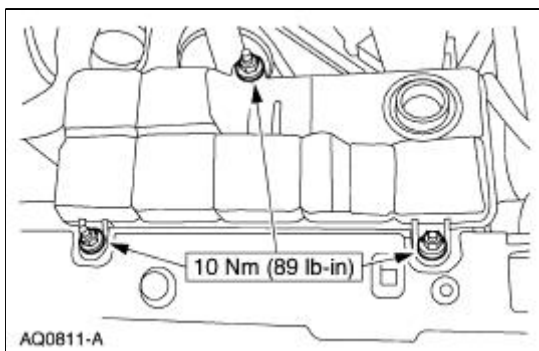
32. Install the power steering reservoir and the fasteners.



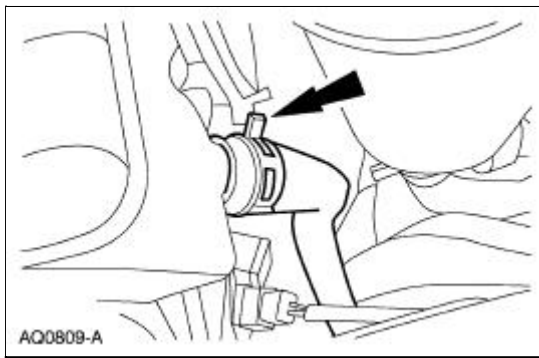
33. Connect the power steering hoses.



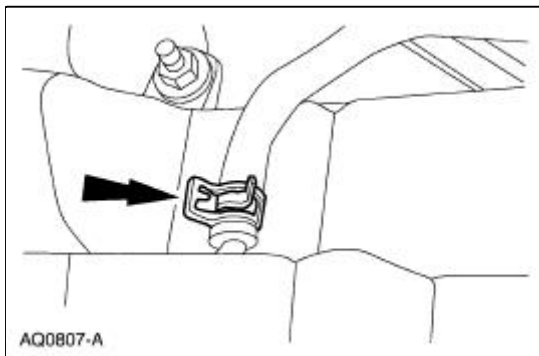
34. Install the engine coolant degas bottle and the fasteners.



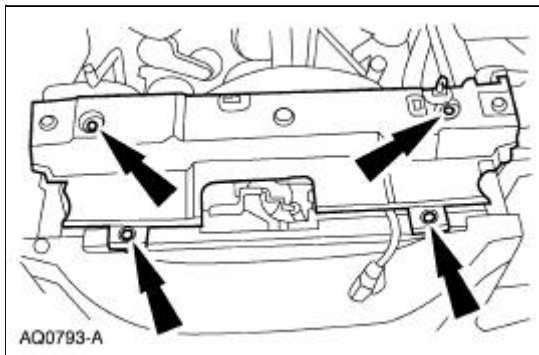
35. Install the degas bottle return hose.



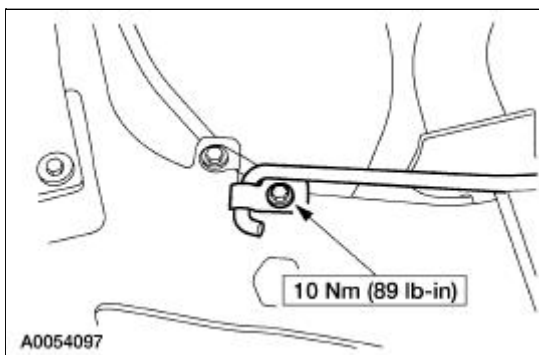
36. Connect the radiator vent hose at the degas bottle.



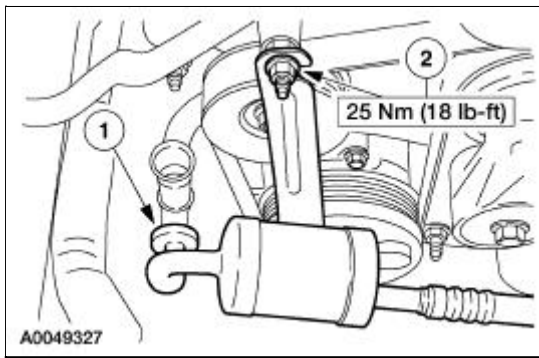
37. Install the radiator sight shield and the push pins.



38. Install the hood prop.



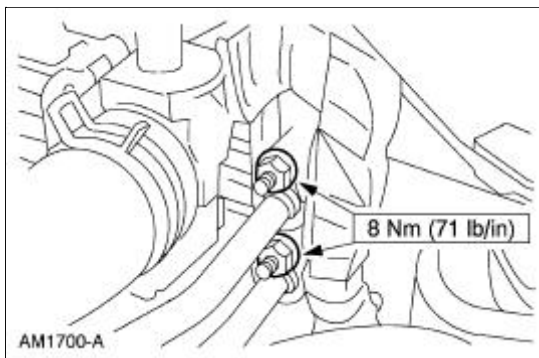
39. Install the A/C muffler.
1. Connect the A/C tube and position the A/C muffler.
 2. Install the bracket nut.



40. **NOTE:** Inspect the O-rings and install new O-rings, if necessary.

NOTE: Lubricate the O-rings with refrigerant oil.

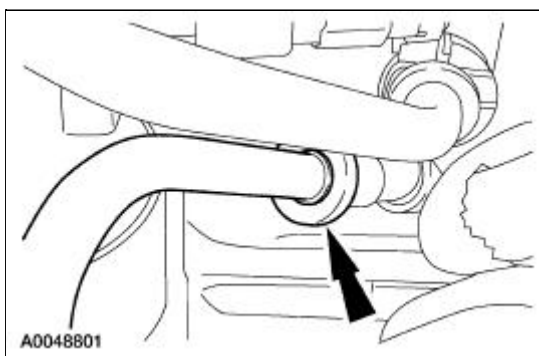
Connect the A/C tube peanut fittings at the condenser.



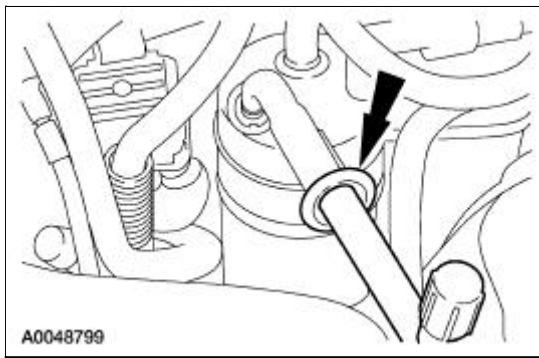
41. **NOTE:** Inspect the O-rings and install new O-rings, if necessary.

NOTE: Lubricate the O-rings with refrigerant oil.

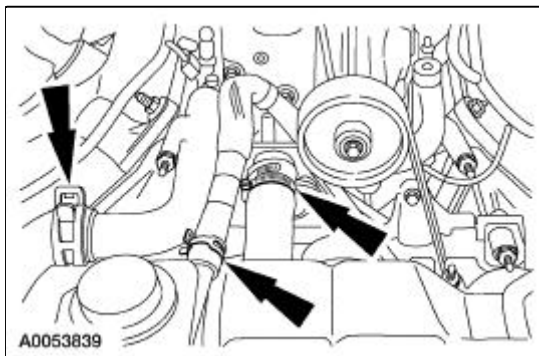
Connect the A/C tube.



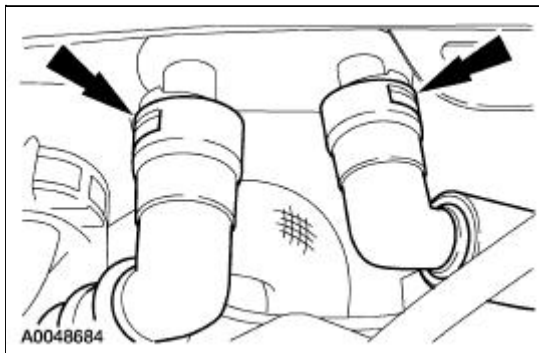
42. Connect the A/C tube at the accumulator.



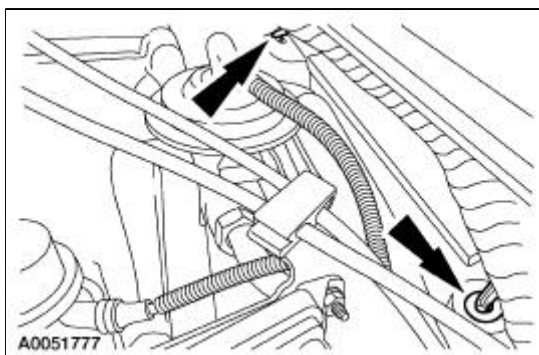
43. Connect the radiator upper hose, the radiator lower hose and the supercharger degas hose.



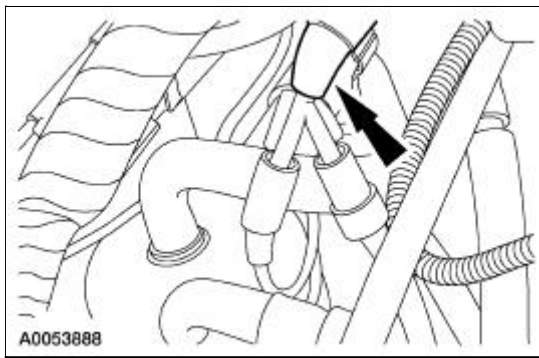
44. Connect the heater hoses.



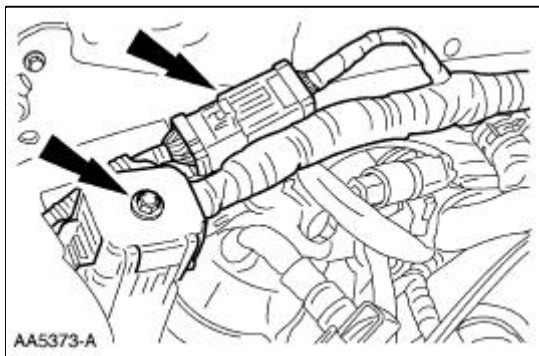
45. Install the wiring harness to the dash panel.



46. Connect the vacuum hoses.

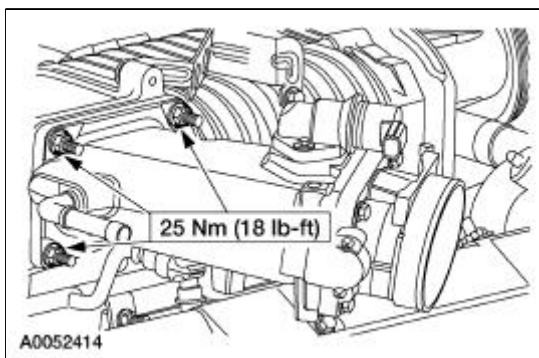


47. Connect the 16-pin and the 42-pin electrical connectors.

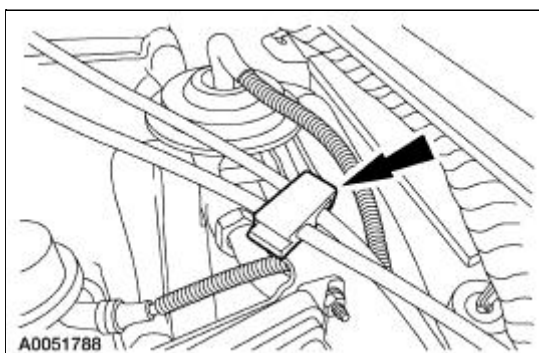


48. **NOTE:** Install a new gasket, if necessary.

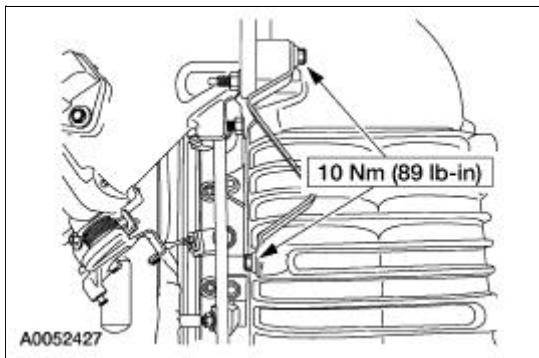
Install the throttle body and spacer assembly and the mounting nuts.



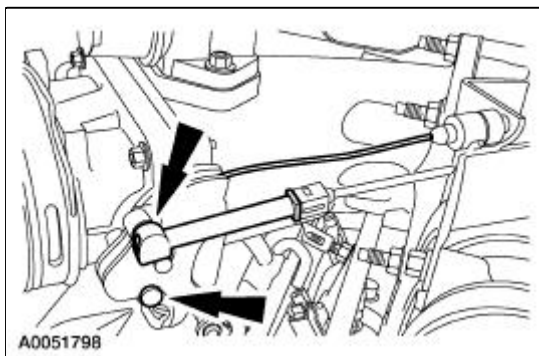
49. Position the accelerator and speed control cables.



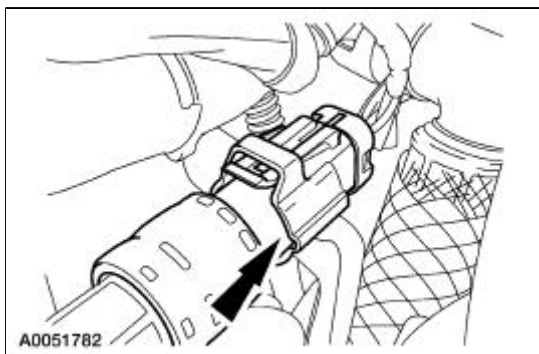
50. Install the accelerator cable bracket bolts.



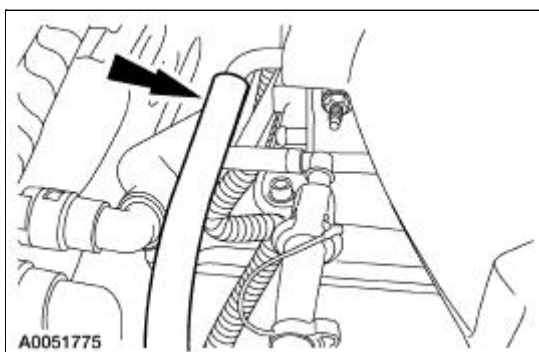
51. Connect the accelerator controls.
- Connect the accelerator cable.
 - If equipped, connect the speed control cable.



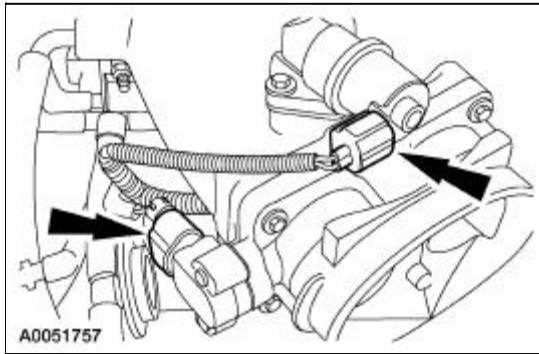
52. Connect the fuel tube spring lock coupling. For additional information, refer to [Section 310-00](#).
53. Connect the A/C pressure switch electrical connector.



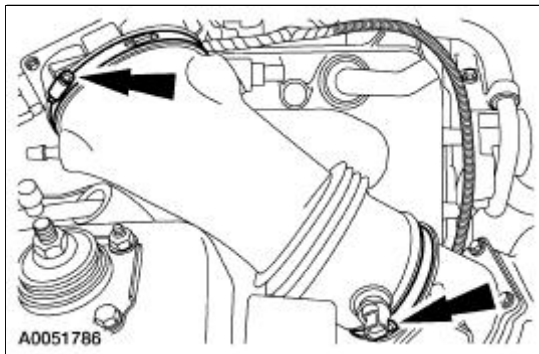
54. Connect the vacuum hose.



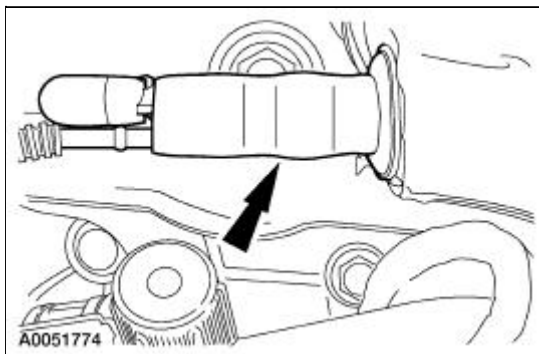
55. Connect the idle air control (IAC) and the throttle position (TP) electrical connectors.



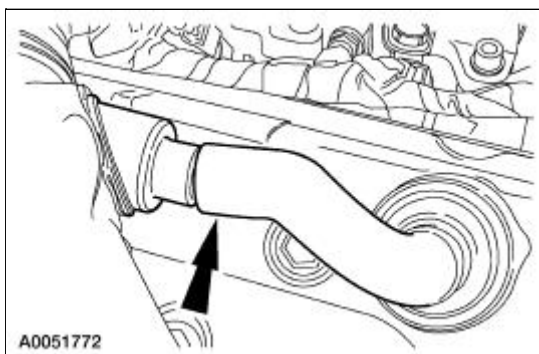
56. Install the air cleaner outlet pipe and tighten the clamps.



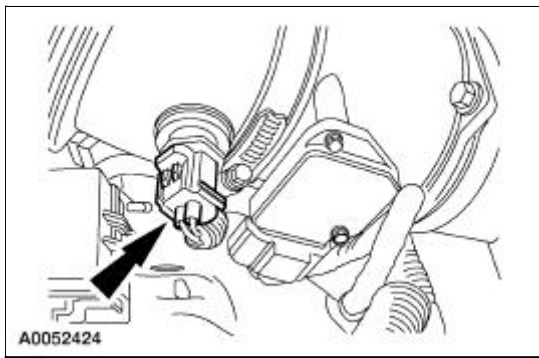
57. Connect the vacuum hose.



58. Connect the breather hose.

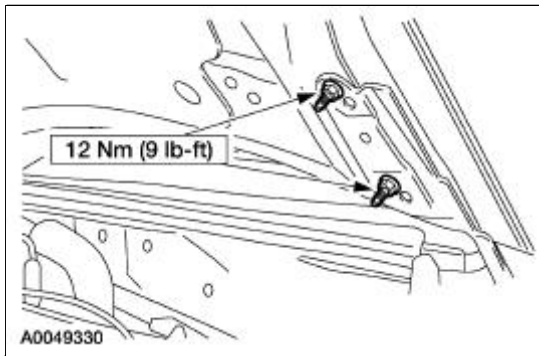


59. Connect the intake air temperature (IAT) sensor electrical connector.

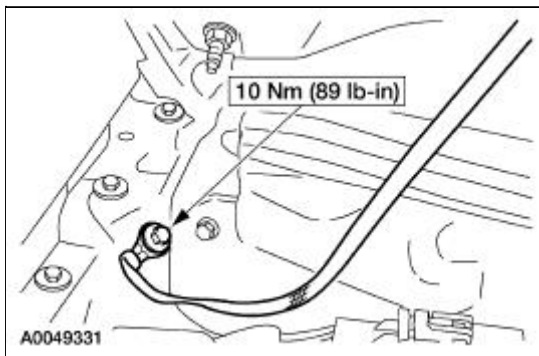


60. **NOTE:** Use reference marks made during removal to aid in the installation.

Install the hood and the four nuts.



61. Install the hood-to-body ground strap.



62. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
63. Fill the crankcase with clean engine oil and check that all other fluids are at the correct levels.
64. Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03A](#).
65. Fill and purge the power steering system. For additional information, refer to [Section 211-00](#).
66. Start the engine and check for leaks. Stop the engine and recheck the fluid levels.
67. Charge the A/C system. For additional information, refer to [Section 412-00](#).
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